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The Organic Farmer

APRIL, 1950
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The Organic Farmer

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by Dr. Ehrenfried Pfeiffer

A beautiful landscape is an index of a *living* soil. The author warns against agricultural practices which destroy the soil. 183 pp., 60 illus. **$2.75.**

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HUMUS AND THE FARMER

by Friend Sykes

How 750 "worthless" acres were changed into rich farmland. 416 pp., 40 photos, index. **$4.50.**

April, 1950

The Organic Farmer

Farming Without Chemicals

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Volume 1, No. 9

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Letters

Farming Fantasy

Dear Sir:

I noticed in the *Organic Farmer* for March you said I had always been "a friend of natural agriculture." If you mean that I whip up a batch of compost now and then and spread it on the land, you are correct. But if you mean that I subscribe to the dogma of organiculture, you are wrong. You should not take a piece of satirical writing like my *New Yorker* story and from it draw conclusions about my husbandry or my beliefs. I am not a friend of any particular kind of agriculture, or it of me. I don't believe there is any such thing as *un*natural agriculture, since all substances are part of nature. I hobnob with bags of chemical fertilizer, and I have never read anything that convinced me that I should confine my friendship to "natural" materials. I once read Pfeiffer's book and used to talk knowingly about the bad effects of chemicals until one day it occurred to me that I had never studied agronomy and couldn't possibly evaluate his ideas without more education.

I use compost because there is a lot of stuff on my place suitable for composting, and it gives me a feeling of improving the soil and seems like a sensible thing to do. On the other hand, I suspect that there are regions in the United States where the sensible way to introduce organic material into the soil is to stimulate crops artificially, thus inducing a heavy growth of organic material in the form of leaf and root —material that otherwise would be missing and unobtainable.

I admit that composting is fun, and sometimes effective. But I also admit that I don't know a darn thing about soils, and anything I do or say is in the realm of mysticism.

E. B. White,
New York, N. Y.

Ed. Mystic White's story undoubtedly was fantastic, but we feel that it has more meaning than a great deal of serious writing we have seen recently.

Oats Prevent Cannibalism

Dear Sir:

In the December issue of *The Organic Farmer* you advise that green hay be used for the prevention of cannibalism.

I would suggest that whole oats be used for this purpose—for both pullets and hens. Oats can be compared to honey—an almost complete food. I begin to feed whole oats when the chicks are three weeks old and increase the amount fed until 7 quarts per 100 pullets is fed twice a day. After 30 to 40 per cent production is reached I reduce to 7 quarts per 100 hens fed at 7 a.m. This amount is continued throughout their laying period.

Brother Lewis Bertrand, C.S.C.,
Notre Dame, Indiana.

Mail Bag Mystery

Dear Sir:

I would like to know what day of the month you mail my copy. I never get it until the last of the month and it comes very wrinkled. I am wondering if several people in Conesville read it before I get it. I don't mind anyone reading it after I get through, but not before.

George E. Westaway,
Conesville, Iowa.

The Right Answer

Dear Sir:

I am a reader of *The Organic Farmer* and I want you to know that I think you have hit the answer to the problem of successful farming. I think that there is only one way to farm the land, and that is by the Organic Method.

I have just a small place at present, but I have experienced marvelous results by using your method.

Henry G. Tetreault,
Canterbury, Conn.

Sherwin-Williams Still To Make Pesticides

Dear Sir:

As a subscriber and as one interested in the organic agricultural process, I am sorry to have to report that your item in the February *Organic Farmer* regarding the Sherwin-Williams Company was in error.

Sherwin-Williams is not dropping

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out of the insecticide market. Far from it, in fact. It is going in for poisons in a bigger way than ever. What is happening is this: they are concentrating on a new product called "Kiltone" which is used exclusively on cotton. They no longer plan to push sales of the familiar poisons that were so much advertised in the last few years.

This information comes from the plant here and was given by a qualified spokesman. The company decided to concentrate on a product which was "basic" with Sherwin-Williams; in other words, something the company has developed itself.

I dare say "Kiltone" will kill just about as many earthworms and other valuable forms of life as any other poison.

Robert C. Stafford,
Strongsville, Ohio.

Ed. The report on Sherwin-Williams activities which appeared in The Organic Farmer was based on an article in a technical journal of the chemical industry. We are sorry to have inadvertently misrepresented the facts

Don't Disk in Frozen Sheet Compost

Dear Sir:

In a recent article you recommended that sheet compost be disked in during the winter when it is frozen. I wouldn't recommend this on land that is subject to erosion, as sheet compost protects the soil during the spring rains.

E. Simpkins,
Kenova, West Virginia.

Useful Information

Dear Sir:

As a graduate of an agricultural college, I find your literature the only thing capable of answering the many questions met with by practical farmers.

J. R. Jones,
Phenix City, Alabama.

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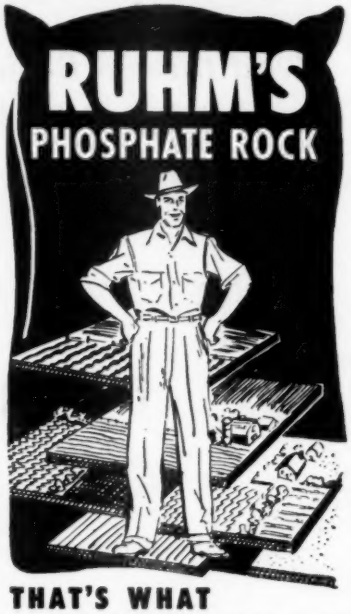

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Queries and Comment

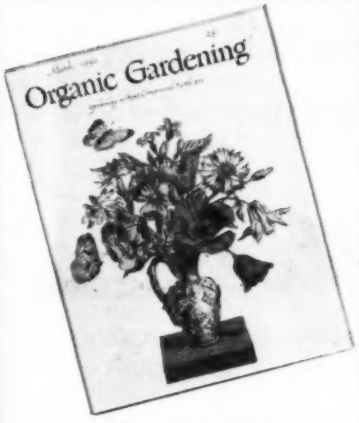
Dear Sir:

In my business of processing farm seeds I get a large amount of seed screenings consisting mostly of weed seeds, hulls, fine chaff, immature seed, etc. It has some value as a feed for livestock. However, it is necessary to grind it as fine as flour to kill the weed seeds, and this takes a lot of power.

I am wondering if this material could be turned into a valuable fertilizer by composting. Do you think there would be enough heat to kill the germination of the weed seed?

Selmer E. Feller,
Hiawatha, Kansas

Your screenings are potentially of high value, because seeds are rich in nutriments. However, they must be composted carefully to make sure that all the seeds are killed. In this case, it would be best to make your compost in open heaps or in pits. Mix one ton of fresh manure with every six or seven tons of seed waste. The manure will supply bacteria that will make the heap heat up rapidly. Make sure that the compost is watered as it is made and that it is turned at least once so that the outside "crust" of the heap will be subjected to the composting action of the bacteria. If you allow the heap to stand for six months, you can be relatively sure that all the seeds will be rendered inactive.



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WIG, Abington, Mass.

Dear Sir:

I have a Bartlett pear tree with a trunk diameter of eight or ten inches. I cannot give the age of the tree as it was here when we purchased the property in 1948. The point I would like to be put right on is—can I fertilize this tree without encouraging blight?

L. Allfree,
Beaverton, Oregon

Yes, you can fertilize your tree without encouraging the blight. Make compost under your tree by using the "ring method." Bring the ingredients to the base of the tree and let them decay there. Place all your raw organic matter in a circle, extending from the trunk to the drip line of the tree. Go easy on nitrogen rich material, because nitrogen encourages the blight. Use large amounts of non-leguminous organic matter. Sawdust would be fine, for it tends to deplete the nitrogen content of the soil.

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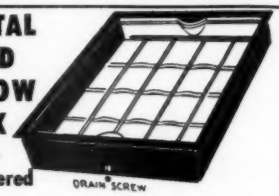

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With the Editor

†*The History of Organiculture*

HERE IS the history of the organic method in this country. When it began in 1942 it consisted merely of the making compost of animal manure and plant matter such as weeds, leaves, sawdust, cannery wastes, or any other kind of residual or salvage plant matter that could be secured, including garbage. Many a farmer has found it worthwhile to haul garbage to feed his pigs whereas it would have been much better if he used the garbage to mix with the manure from the pigs to make compost, to grow the crops to feed those same pigs. They would be much healthier. And it is a known fact that garbage-fed hogs have twice as much trichinosis organisms than those which are not fed garbage. Trichinosis is transmitted to human beings. In a recent survey in Cleveland, Ohio it was found that ½ the population suffered from this disease.

In making compost Sir Albert Howard found by experiment that the best compost consisted of three times as much plant matter as manure, for that is the way he found it when nature made her compost in the field and in the forest.

We were highly criticized that compost was not sufficient, that if there were deficiencies in the soil, the compost made from plant matter coming from the same land would not correct it. Sir Albert Howard's answer was that if the farmer made sure to obtain some leaves each year to include in his compost that would suffice, because the roots of trees go down twenty-five feet or more and bring up in the leaves minerals which are present in those unexhausted levels.

Where shall the farmer get leaves? In nearby towns. My two men this past season hauled in one week's time 100 tons of leaves from a town several miles away. I value leaves at $10.00 a ton. Here is $1,000 worth of material which we salvaged in one week's time at a season of the year when my men were not busy and could find the time to do it. We ran the leaves through an ensilage cutter and applied them to a soil as a mulch in October where we intend to grow corn next May. I consider leaves more valuable as a fertilizer than manure. Leaves are more of a whole thing, whereas manure is a residue, it is only a part and may lack essential elements.

Of course there are some sections of the country, like the sandy soils of Florida, where there are serious deficiencies, and in those cases something more is needed, such as phosphate rock which contains over 20 trace mineral elements.

After a few years we began to recommend that ground up raw phosphate rock be added to the compost or spread directly on the land. This fertilizer corrects many deficiencies.

The raw phosphate rock is used in making the chemical fertilizer called superphosphate, but we object to the latter because in its manufacture sulphuric acid is added to the raw phosphate rock.

Now we began to make a little more progress. The organic method was getting a little more practical. It was growing up. We had more to offer.

We soon made another improvement. In the original Sir Albert Howard process, the compost heap which was about 30 feet long, twelve feet wide and five feet high, had to be completely turned over twice, once at the end of three weeks and once at the end of 8 weeks, and there was much howling about this because it usually had to be done by pitch-fork as few farmers had the manure loader attachment on their tractors which could accomplish this work in minutes as against hours.

We did away with the turning operation by putting into the heap

earthworms which we bred ourselves for this purpose. You had to put about 30,000 to 40,000 earthworms in a heap to make an impression, and they worked in it, chewing it up and churning it about and made a very fine compost with their own manure and secretions.

I think in the future earthworm breeding will be done on almost every farm. It is simple to do and provides a wonderful feed for chickens. We feed earthworms to our chickens every winter when the ground outside is frozen. This should be a wonderful all-year-round feed to chickens which are confined indoors all the time.

Let me give you an experience we had in the first year with our chickens before we raised organic food for them. One of them became paralyzed and lay in a corner, refusing to eat.

In a day or two it would have died. Poultry people can do nothing with such cases. I had remembered a letter we received from one of our readers who had 3 paralyzed chickens and who claimed to have completely cured them by feeding earthworms. We began to feed our paralyzed chicken earthworms. In 3 days time that chicken became completely cured and was running around with the others, clear of eye and full of vigor. There is something in this that should be investigated by poultry scientists.

Coming back to the history of the organic method, from the very beginning we recommended green manuring and contour and strip farming. We also recommended the use of ground limestone and good crop rotations. In other words it is always advisable to be a good farmer.

In connection with plant matter to be used in composting, we insist that some of it should come from sources outside of one's own farm. Although it is surprising how much can come from your own place—such as corn cobs, leaves, roadside weeds, spoiled hay, table garbage and tree prunings (which can be ground up in a new machine which is now available)—it is all the more surprising to see how much plant matter can be obtained free from outside sources. We get tons of corn cobs free from a feed mill. Nobody wants them and they have been burning them up. Yet the corn cob is said to have 2/3 the nutrient value of the corn kernel. There is available sawdust, leather dust from shoe factories, cannery wastes, city garbage, poultry shop waste cuttings, apple pomace at cider mills, brewery wastes, spent mushroom manure, cocoa wastes, chicken hatchery wastes, etc., etc.

Lazy farmers can purchase organic matter such as animal and vegetable tankage, castor pomace, cottonseed meal, bone meal and spoiled seed at feed dealers.

The U. S. Industrial Chemical Co. is experimenting with a waste organic molasses product to make it into a powder for fertilizer use. Molasses is a wonderful food for soil bacteria. It is being used extensively as a fertilizer today in India.

I suggest that farmers experiment with small amounts of certain ground up seeds, such as nitrogen containing soybeans, for use as fertilizer. 100 pounds per acre added to other, salvage plant matter would cost only six or seven dollars per acre.

The important thing in applying these raw organic plant residues is that you must not plant on top of it, but must give it two or three months to decay in the soil. Otherwise, it must be left on top of the soil as a mulch.

The next improvement in the organic method was to recommend ground up raw potash rocks, such as granites and glauconites. Here you have raw potash without the addition of any acid that you get in the muriate of potash. There are granite quarries and other rock quarries, the owners of which do not know that if their product were ground fine enough they have a wonderful fertilizer to sell. I was instrumental in putting a man who owns such a quarry into the fertilizer business. He was selling it as poultry grit and is now selling his rock in carload lots through an advertisement in our magazine.

In review then, we recommend the use of as much organic matter as possible, ground limestone, green manure crops, raw phosphate and potash rocks, contour and strip farming and good rotations.

You might ask how about the nitrogen? In my 8 years of farming and in that of thousands of others using this method we see no nitrogen deficiency. The crops are the censors. You look at the leaf, at their color, at the yields and see no deficiency of nitrogen. Why? Because organic matter is known to possess 5% of this element. If you apply some organic matter each year that originates outside of your farm you will not have to be concerned over the land's nitrogen requirements.

Here is another thing. You know that when you plant a leguminous crop the bacteria in the nodules on the roots extract nitrogen from the air, but did you know that if your land is well supplied with organic matter, it causes certain free-acting nitrogen-gathering bacteria to multiply—the azotobacter, which get nitrogen from the air free of cost to the farmer. No, nitrogen is no problem to the organic farmer, as we can see from our yields. We put no nitrogen as such in our soil and our yields are about 40% higher than the average for our section.

I must speak now of a revolutionary change we announced in the organic method last Fall. We did away with composting in heaps. We did this because we observed 3 weaknesses in the compost heap. First—there are liquid leachings from the bottom, irreplaceable losses. You do not grow a crop at the site of a compost heap. We noticed when the site was empty, weeds would grow there 3 times higher than those next to it. Secondly, there are oxidation losses from above, especially of nitrogen. There is a tremendous compaction of the matter in the heap, a burning out of some of the nutrient elements. Thirdly—there is the double work

THE ORGANIC EXPERIMENTAL FARM NEAR EMMAUS

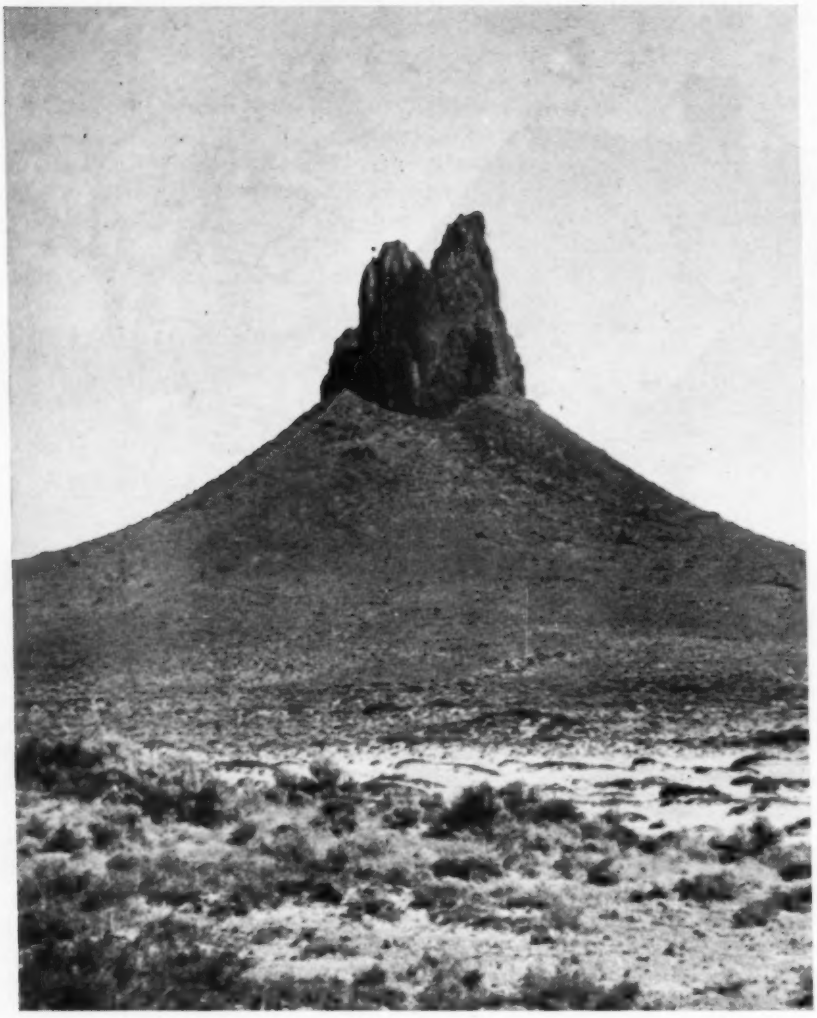
of making the compost and then moving it to the field.

So we worked on the idea of taking all the ingredients that would have been put into a compost heap and applying them direct to the soil, either in places where crops are not growing, or as surface mulches, and the idea has reacted wonderfully with practitioners of organic farming as well as with newcomers to the idea. Now, they say, we are cooking with gas. We have taken out a great part of the extra work incidental to the organic method. This method is called sheet composting. Another application of sheet composting is to apply manure over a growing green manure crop in a thin layer which gradually composts on the surface. In a few months the green matter and manure are plowed under.

Now we have a most practical package to offer to the farmer. There may be one or two situations where composting may still be advisable, such as when manure accumulates in the winter time. We are experimenting with a new method of composting, an enclosed silo method, eliminating losses from above and below. In the garden, with such material as garbage, we would not want to use it as a mulch so we recommend composting it also.

We are often asked—is the organic method practical on a large farm? The answer is that it is today being practiced on many large farms. Off hand, I can think of only a few, the Koble Farm in Mt. Morris, Illinois of 500 acres, the Kendall farm outside of Boston of about 500 acres, and the Gandy farm near Buffalo of 200 acres. The farmer today has more time than he used to, since he has so much labor-saving equipment. In 1880—it took 152 hours to produce 100 bushels of wheat. Today to get that quantity requires only 46 hours. The farmer has more time today to scout around and find free organic matter. He will also have to learn how to handle various kinds of organic matter to his best advantage so as not to give the soil indigestion. We have the experience and will be glad to help any farmer to start this method.

A large farm, with their savings from discontinuing the use of chemical fertilizers, could operate a commissary department with one or two men whose sole function would be to secure organic matter from areas not too distant from their farm. That could very well become the most valuable department on the farm.



This rock protrusion is the plug of an old volcano. Its rock contains potassium in a form that is available to crops.

Fertilizer

Native Rocks As Fertilizer

Here is the answer to many challenging fertilization problems

By DR. W. D. KELLER

Professor of Geology
University of Missouri

THE RICH fertility which characterized the choice virgin soils discovered by the first settlers of our country has often been called an irreplaceable, squandered heritage. It was a heritage, no doubt, and in many places it was squandered, but to think of it as being irreplaceable or unrestoreable is an indulgence in self-pity and an expression of sheer mental and physical laziness. Almost any level of fertility can be restored.

The first step in the restoration is to ask ourselves from whence and how did the fertility originate. Then action must be taken to duplicate the process by which Mother Nature assembled such a wealth of richness in the top soil. The procedure cannot be impossibly complicated, and need not be the least artificial, because the fertility came by natural means and not by the hand of man. This observation leaves a clue to the method to be proposed to utilize naturally available earth materials and to follow the paths of nature.

Origin of the Primary Fertility

The fertility of the virgin soil represented a long-time accumulation or concentration of nutrient elements which were derived from two main sources. One of these was the organic contribution from a long parade of previously growing plants. The other nutrient elements were liberated by the rocks which weathered to form the body of the soil and its accessories. Both contributors were important, but the purpose of this article is to focus chief attention on the rock-derived nutrients.

Solid rocks in various parts of the earth contain all of the natural elements that have been found. They contain, over widespread areas, the main nutrient elements, except for nitrogen, upon which plants evolved their botanical kingdom. Mineral nitrates are severely localized in their occurrence, but the air contains an abundant reserve readily available for fixation by the appropriate plants.

The solid rocks, although rich in reserves of plant nutrients, are inhospitable donors of them to plants until they (rocks) undergo weathering. Rocks upon weathering give rise to soil material, nutrients, and accessories which possess the following important characteristics.

See glossary of geologic terms used in this article on page 45.

The most voluminous of the weathered products consist of sand, clay, and yellow, red, or brown iron oxides. These form the body of the soil, a foundation and support for the roots and plants growing thereon.

During the breakdown (alteration) of the rocks and minerals, they release in soluble form, compounds of potassium, phosphorus, calcium, magnesium, sodium, and those of the trace elements such as manganese, copper, cobalt, zinc, boron, and others.

Third, and not the least by any means, the weathered clays (along with the organic matter) act as a media of transfer which bridge the gap between the inorganic, lifeless rocks and the living plants. Through the action of the colloidal fraction of the clay and humus, the elements listed above are taken from solid rock and are made available in a useful form to the rootlets, thereby becoming nutrients to the plants.

Nutrient Transfer Via Clays and Humus

The mechanism of nutrient transfer merits a more detailed explanation because it will introduce logically the qualities desired in a rock to be used as a donor of nutrients—that is, as a fertilizer. The clays and humus present in an especially fertile soil will themselves be well charged with readily available plant nutrients, much like a strong storage battery in an automobile is fully charged with electricity. Both contain appropriate energy to withstand at least one season or campaign.

In the case of the soil, plant rootlets come along and withdraw much of the nutrient supply from the clay and humus and exchange hydrogen (acidity) for the calcium, potassium, etc. that has been removed. That leaves the clay and humus in a partially "discharged" condition, like the storage battery after a severe drain on it. The acid clay and humus are ready to be recharged with nutrient elements if any can be found in contact. Indeed, the situation is more drastic than that, for the acid clay and humus are positively aggressive toward any adjacent rock fragment.

To establish chemical balance they attack, react with, or weather—call it what you wish—the adjacent rock particle and strive to extract atoms of potassium, calcium, etc. from the rock. This weathering action by acid soil and organic matter on rock particles breaks down the rock into more clay, more soil, and releases the desired nutrients.

Obviously, a useful and generous rock donor must have at least two qualifications. First, it must contain in its mineral and chemical composition the elements which are useful as plant nutrients. Second, the rock must be one that is relatively susceptible to attack by acid clay and humus. Some rocks are known by geologists to weather easily, whereas others are known to resist alteration most stubbornly. These types will be considered later.

The average chemical compositions of various rock types are well known, and specific compositions are readily determined by chemical analysis. Actually, the mineral composition is often more important than chemical composition because the same chemical elements (nutrient elements) may be crystallized in different ways in unlike minerals, and those unlike minerals (containing the same elements) respond in different ways to soil reactions.

To return to the storage battery analogy, the rock particles in the soil are the generators which keep the clay and humus fully charged. A fertile virgin soil is one whose clay and humus are highly charged with available nutrient elements. It

Native Rocks as Fertilizers

Continued

will become exhausted within a short time unless rock particle reserves are present to recharge or replenish the available nutrient reservoir. This illustration may help explain why some soils become exhausted in a short time, whereas in others the fertility is long enduring.

Organic farmers know the value of providing humus which, with clay, transfers nutrients to roots very efficiently. The next requirement is to add rock or other materials which will function as a reserve (recharge) supply of those nutrients.

Natural Versus Processed Additions

Two practices for adding nutrient reserves to a soil may be followed. One of them is to add commercial fertilizer, which may be characterized as being conventionally a highly processed (usually by chemical means), concentrated, quickly soluble compound containing a few selected elements. The use of it may be thought of as dosing the ailing soil-patient with a quickly assimilable, concentrated, processed, stimulant-food to revive its strength. Each stimulating dose must be repeated as the preceding one waves in strength. Organic farmers abhor such a practice.

Another procedure to restore soil reserves may be called the natural, long-term, geological scheme. Hereby are added in clay, silt, and fine-sand sizes, carefully chosen, and perhaps blended mixtures of native rocks and minerals. The rock and mineral particles will weather and decompose rapidly in the soil from a geological viewpoint, but slowly compared to reactions in the laboratory; they will supply a long lasting, full-diet, soil builder. The elements and nutrients liberated will be considerably more diverse than those of the more nearly pure, processed fertilizer, and will normally include the trace elements. The intention is to fertilize as nearly as possible according to the principles followed by nature in soil building.

The disadvantages to the use of processed chemical fertilizers are well known to the readers of this magazine. There is no need to enumerate all of them, but one will be discussed which can be avoided by adding native rocks. A conventional processed fertilizer is so highly soluble that soil solutions from it tend to overstock the clay and humus from which the plants accept their nutrients with an over-supply of the few elements contained in the fertilizer. The concentrated overstocking suppresses the availability of other elements also sorely needed by the plants for full growth; it prevents the plants receiving a normal "balanced diet". By forcing an over supply of some constituents it creates nutrient deficiencies in others—despite the purpose of adding it being to correct deficiencies.

The natural way for plants to take up nutrients is from a diversified set of source points, but not by dousing with a concentrated solution. Albrecht described the process most clearly when he wrote:

"It seems more reasonable to believe that the plant is growing much better if its advancing roots find one area around a limestone particle that may be more nearly neutral but providing much calcium, then at some distance another area more acid, where iron can be taken, then another where around some feldspar its potassium is slowly made available, then another when the acidity is mobilizing the phosphorus, and still others where manganese and the different essential nutrient elements are in the clay in exchangeable form because the clay is in contact with some mineral fragment and maintains itself in a weathering equilibrium with it".

Quite clearly, the addition of properly selected crushed rock particles to soil will make possible the system just described.

Effective Rock Types, Calcium Donors

Earlier in this article it was pointed out that a rock which served as an effective reserve donor of nutrients must have the proper mineral-chemical composition, and that it must be readily susceptible to reaction with acid clay and humus. In the following discussion a wide variety of potentially useful rock examples will be offered, but the topic can be covered in only a generalized way for the following reasons.

Highly technical rock names, although necessary for precise geological classification, would be meaningless to non-geological readers. Moreover, special or unique deposits of certain rocks may have only local occurrence and would not have general interest. After one grasps the general considerations involved, he is in a good position to make special inquiry into an individual situation. Information on specific rock formations or deposits is usually best obtained from state geological surveys.

The most widely used agricultural stone (agstone) is limestone. Right at the outset it should be emphasized that the function of limestone is to supply calcium. Calcium is a nutrient element, and limestone is a fertilizer rock. It neutralizes acidity incidentally, simply because the acid clay or humus reacts with the calcium carbonate of the limestone to take on calcium in place of the hydrogen (acidity). After that reaction the calcium becomes available to plant rootlets. Ordinarily, other nutrient elements also absorbed by the transfer substances are less strongly held in the presence of abundant calcium.

A word of caution may not be amiss here. It is possible to douse the soil so heavily with very finely pulverized limestone that the over supply of calcium will blot out the availability of other elements as completely and as seriously as the effect

described by the action of highly soluble processed fertilizer. Not all of the active acidity should be neutralized, for some of it must be left to mobilize nutrients which are available only in a modified acidic environment.

In the past, great emphasis and high preference were placed on the purest calcium limestone. That attitude resulted from the misconception that neutralizing power represented the value of limestone. Preference is now swinging toward limestone which contains a variety of elements other than calcium. Impure phosphatic limestone, or limestone rich in trace elements will contribute to a more diverse range of fertility than one restricted to calcium. "Variety agstone" may be preferable to high calcium limestone. Remember, the primary function of limestone, is to fertilize, not to neutralize.

Calcium may be supplied in the form of gypsum (calcium sulphate) which is slightly soluble in water without the action of soil acids. Hence it is useful in the alkali soils of the drier western states. Sulphur may be needed on some soils and gypsum furnishes sulphate.

Certain gypsum deposits, especially those from hot springs, may contain elemental sulphur disseminated through the gypsum. Apparently the combination, and the free, elemental sulphur have produced striking plant responses on soils in need of the combination.

Raw rock phosphate, which contains both calcium and phosphorus, can be a wonderful replenisher for soil low in phosphate. Besides supplying the two elements mentioned, some trace elements may also be present in the phosphate rock.

Magnesium-Containing Rocks

Dolomite, a rock and mineral which contains both calcium and magnesium, has not received the attention it deserves. Magnesium is a vital and essential part of chlorophyll, hence the content of magnesium in soil should never be allowed to sink to deficiency level. Unpublished research suggests that the health of animals is adversely affected when eating plants grown on magnesium deficient soils. The magnesium to calcium ratio in soil should not be less than one part magnesium to six or ten parts of calcium. Overliming with high calcium limestone when magnesium was needed has been very distressing because it has exaggerated the unbalance of magnesium to calcium, and because it neutralized acidity which is necessary to react with dolomite in case the latter is finally added.

In regions where the underlying rocks are igneous and metamorphic types (granites, basalts, gneisses, schists, or slates) and no limestone or dolomite occurs nearby, calcium may be obtained from rocks rich in high-calcium feldspar (plagioclase feldspar). Anorthosites, gabbros, basalts and alkali-varieties of these types will be reacted on by acid

Grapes and pines growing in potassium-rich volcanic dust on the flanks of Vesuvius in Italy. Very little soil development had taken place when this picture was taken in 1945.

Native Rocks as Fertilizers

Continued

clays and humus to release calcium, as was demonstrated by Dr. E. R. Graham (Soils Department, University of Missouri). These silicate compounds of calcium are more resistant to weathering than are limestones, hence the response of a soil to them is slower.

The mineral olivine (magnesium iron silicate), and the rocks dunite and peridotite, which contain olivine, are weathered by acid clay and humus thereby releasing magnesium. In New Zealand, it has been common practice for years to mix dunite with super-phosphate and thereby enhance the value of both as fertilizer.

Potassium Rock Sources

Potassium occurs in an easily weathered green mineral called glauconite, the main mineral in the "greensand" of New Jersey. Glauconite and glauconite-bearing rocks occur in quantities large enough to be of practical value in perhaps one-third of the states in the U. S., notably along the Atlantic and Gulf coasts. Glauconitic dolomites are not uncommon. They will furnish potassium, calcium and magnesium and cost no more to quarry than any other limestone. Mass production of glauconite from large reserves in the east could average about 6 per cent potassium without any chemical processing, of course.

Other minerals notably high in potassium are leucite and alunite. Whole mountains, about 2 billion tons of leucite-containing rock occur in the Leucite Hills of Wyoming. A representative analysis of this rock shows more than 9 per cent potassium oxide, about 6 per cent calcium oxide, 7 per cent magnesium oxide, almost 2 per cent phosphorus pentoxide, and trace elements. Quite an assemblage! Leucite also is fairly susceptible to weathering.

A classic example where fertility is quickly developed from leucite-containing rocks is the region around Vesuvius and Naples, Italy. The volcanic cinders and dust which were thrown out of the volcano of Vesuvius and spread for miles about are high in leucite content. Oranges, grapes, gardens, and pine trees grow luxuriantly in the almost unweathered rock particles long before a soil profile is developed. Indeed, insufficient time has elapsed since the historic and catastrophic eruptions of Vesuvius to develop a mature soil, yet many seasons of crops have been grown since that area was devastated by volcanism. Vesuvius lava typically contains about 8 per cent potassium oxide, 8 per cent calcium oxide, 4 per cent magnesium oxide, 1 per cent phosphorus pentoxide and trace elements. Vesuvius cinders and dust would be wonderful supplements to the lean sands of Florida. Both areas raise oranges, vegetables, and varied fruits.

The similarity between the Vesuvius rocks and the Wyoming leucite rocks is notable. Furthermore, the leucite basalt which occurs in great quantities in the Highwood Mountains of Montana is also similar to the other two. A typical analysis of it records almost 6 per cent potassium oxide, 9 per cent calcium oxide, 10 per cent magnesium oxide, more than 1 per cent phosphorus pentoxide and trace elements.

In Arkansas, at Magnet Cove, a rock named arkite contains more than 8 per cent potassium oxide, more than 8 per cent calcium oxide, and small amounts of magnesium oxide and phosphorus pentoxide.

This list does not exhaust the known occurrences of the potash alkali-rich igneous rocks. They, with the glauconite in the east, give widely scattered coverage across the United States for potassium.

Alunite and alunitized rock, which contains potassium oxide theoretically up to 11.4 per cent, occurs in association with ore deposits in Utah, Nevada, California, Colorado, Arizona and elsewhere.

Granites, which are wide-spread in occurrence, contain potassium by virtue of their having potassium feldspar in their mineral composition. However, both geological field observations and laboratory weathering tests show that the potassium feldspar of granite weathers slowly and less effectively than does leucite. Although reports from users of granite on soil have been enthusiastic, this writer cannot recommend granite as a fertilizer nearly so highly as the other rocks previously mentioned because of its sluggish response to weathering.

Volcanic ash or dust ordinarily is more susceptible to weathering than the equivalent crystalline igneous rocks because the dust is usually a glass, is fine-grained, thin-edged, and is porous in structure. Glasses decompose more readily than do chemically equivalent crystals, and the other physical properties also implement weathering. In many respects volcanic dust is close to the ideal, naturally-pulverized rock fertilizer.

Slags from metallurgical furnaces may be high in calcium and magnesium content, and many of them are rich in the metallic trace elements. Portland cement clinker contains desirable nutrient elements as is shown often by stimulated plant growth at the edge of cement slabs, sidewalls, paving, or foundations. Cattle like to graze the plants growing near concrete because they contain extra nutrients. For the same reason cattle lick plastered walls. By-product or waste products due to improper "burning" of lime, dolomite lime, or dolomite refracteries may be effective as rock fertilizer.

After all, the properties desired in a rock fertilizer are the proper mineral-chemical composition, and ready decomposition of it by ordinary weathering agencies. Any material which satisfies those requirements can be used.

Pulverizing of Rock Essential

Decomposition of the rock fertilizer will be facilitated if the rock is finely pulverized. Thin, sharp edges of rock can be attacked by solu-

(*Continued on page* 45)

Pasture Partners

Sheep and chickens work together to produce a balanced pasture

By WILLIAM GILLMAN

Photos by E. Gillman

WHEN Earle Fowler started with hens 33 years ago, there wasn't much poultry science to guide him. But he did have a dollar-and-sense practicality which led him to work with nature, not against her.

The result is a highly successful poultry farm near Manchester, Vt., where he and his son Robert even use sheep in thoughtful grassland methods which reap from the soil without mining it. Theirs is the best pullet pasture this writer has seen in New England.

The Fowler range happens to be on a sidehill, where rainfall if uncontrolled could cause ruinous erosion. But here rain falls on a turf under which healthy soil drinks it in and holds it on tap for dry spells. This soil hasn't been drenched with commercial fertilizers which tend to form an impervious hardpan.

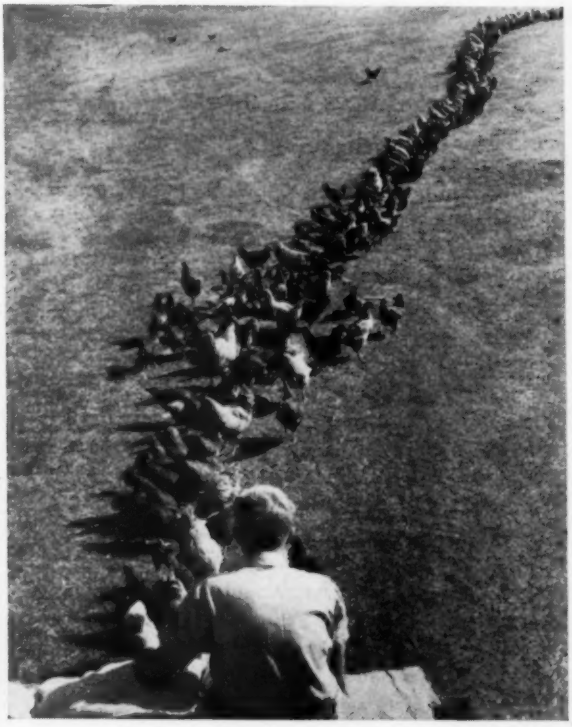
Thanks to the small flock of sheep rotated through the range to keep it mowed properly, and to genuine fertilizer which they and pullets supply, the range looks like a rug.

There's more to it than striving for mere prettiness. Short, succulent grassy shoots of that kind—rich in proteins, vitamins and minerals—mean money saved on the healthy 2,500 replacement birds raised yearly for the laying flock of 3,500. Inasmuch as good pasture is known to net a saving of four pounds grain per growing bird, Fowler figures on five tons saved annually.

As for the two dozen Suffolk ewes and their crop of around 30 dressed lambs, Fowler says the old rule still

By working with Nature, Earle Fowler has built up a superb poultry range of succulent and highly nourishing native bluegrass and white clover for the Rhode Island Red pullets and Barred Rock cockerels he grows to produce hatchery eggs.

Ground feeding of scratch and pellets from rear of a truck at Earle Fowler's poultry farm not only saves time but helps keep range in top condition. Birds damage turf less than when hopper-fed. Truck takes different route each time.



Earle Fowler explains conformation points of Barred Rock cockerel to Charles Parmelee, summertime student helper from the University of Massachusetts. Slightly over five months old, this bird is from pre-Christmas hatch which annually begins Fowler's replacement program.

Pasture Partners

Continued

holds true—wool pays costs and lambs represent profit.

All this fits a time-table that he has evolved to make the pasture needs of growing pullets and lambs match the period of most abundant grass supply. The same time-table enables their egg and meat products to be sold for what a Vermonter calls "the top dollar."

The sheep are fairly recent. It was 19 years ago that Fowler started experiments aimed at having good poultry pasture with less work. Like others, he had been moving cumbersome range shelters. He stopped the rotation and saw his birds doing nicely on their permanent pasture. Where newly seeded pieces had frequently been chopped up or muddy, pullets now grazed on a firm sod.

He also saw room for improvement. Fowler knew that the birds got most nourishment from tender, young shoots of grass and clover. This was the pasture's condition in early spring. But it wouldn't be long before grass got away from the young birds and became tough. As an antidote, Vermont's extension poultryman, Donald C. Henderson, advised mowing. Fowler began doing this with a mowing machine which his truck pulled over the range three times a season.

This provided a constant supply of succulent pasture. It also paid in reducing disease problems. Keeping the grass cut allowed purifying sunshine to penetrate to turf roots more easily. This discouraged snails and other hosts to parasites. Fowler saw that his pullets were suffering from less range paralysis and other common infections.

As his flock increased, he worked out a simple method for enlarging the range. He merely placed new shelters into hayland which had originally been seeded to timothy and red clover. Every other year, for the first few years, he balanced the poultry's nitrogenous manure with lime and phosphate, and nature did the rest. As timothy and red clover disappeared, native bluegrass and white clover moved in to replace them with nourishing permanent greensward.

The next experiment was forced by the war when Fowler wanted to reduce labor more. In place of the mowing machine, he tried grazing cows on the range. But they left too many disease-breeding clumps of grass.

Fowler talked it over with County Agent J. A. McKee who suggested trying sheep. He pointed out that their fairly close grazing helps maintain a grass cover, and their trampling compacts the soil, thereby producing conditions for good turf.

When Fowler learned there was no disease common to chickens and sheep, he went ahead and discovered that the wooly animals were splendid lawn mowers. They had a fondness for poultry grain, but this problem was handled easily by having hoppers always on the other side of the fence.

There are three main ranges of two acres each, and two more of an acre apiece. Sheep rotate through them, eating grass along with the birds. Hip-high sheep fencing separates the ranges. Pullets can go through it, but the sheep cannot. Every two or three days, they are moved on to another range.

Still another innovation was successfully introduced last year by son Robert who has taken over the outside work on the farm. To reduce labor and encourage pullets to range farther from their shelters, he abandoned hoppers in favor of ground feeding. Scratch feed and pellets are spread from a truck which takes a different route each time. This keeps both truck and birds from tearing up any one spot, and an entire feeding operation can be done in 10 minutes.

The upshot of it all is that, although part of the range has been pastured continuously for 19 years, it still looks like a golf course.

Similar alertness shows all through the operations, and allows the two men to make a nice living from the small farm. It sells a half million eggs yearly—every one candled and graded. As a result, the Fowlers are paid premiums for not only table eggs but their main crop, which is production of Rhode Island Red-Barred Rock cross hatching eggs that are sold for broiler chick production.

The Fowler schedule aims at selling most of their produce when it

brings highest prices. The same time-table saves the range from being over-grazed when grass growth slows down in mid-summer.

It works like this: lambing time was moved ahead to February. Grazing begins in mid-April when grass starts in being lush. By July, lambs are of the size preferred by private freezer customers. Young birds are also doing most of their growing when grass is at its best. Hatching begins in late December, and birds join sheep on the range in early spring.

Housing them for laying begins in June, and enables the Fowlers to hit peak prices with heavy egg production. In this, the 2,500 pullets are joined by 1,000 "swing shift" hens wintered over for a second summer's laying. In November, when egg prices drop and meat prices are high, the Fowlers do their heavy culling which leaves them with the 1,000 birds they over-winter, plus 200 saved for breeding replacements.

So that part of the Fowler success is due to alert marketing. The rest is based on a realization that nature is ready with a helping hand for the poultryman smart enough to co-operate with her.

Sheep are valuable helpers on Earle Fowler's poultry farm where a sidehill has been converted into an enviable pullet range. They "mow the grass," build up a rain-absorbing, compact turf, and add natural fertilizer which keeps greensward in top condition.

Birds go through the fence but sheep can't. By rotating sheep through parts of the range, Robert Fowler keeps them busy mowing grass, prevents them from stealing pullet grain when it's hopper-fed.

Increasing Citrus Vitality

A Rio Grande grove operator finds success with organiculture

By E. M. CARD

From Texas Farming and Citriculture

HAVING been absorbed for forty-one years in engineering work in the Valley and trying to grow citrus by proxy, employing a manager, the writer has believed for a long time that the common practices for sustaining soil fertility can be much improved. Last summer I burned my bridges behind me as to professional work and visited California to observe there the practices and results in the care of citrus groves.

Exhausted Soil

I inspected many groves and talked with numerous citrus authorities at the Experiment Stations and elsewhere. What I discovered amazed me. On thousands of acres the soil has been exhausted. Many old groves are producing fruit that is sour and too small for the fresh fruit markets. Fruit refused by these is sold at ten cents a glass at stands strung along the highways.

Production per tree is down. A man who has grown old with his grove told me that his trees were planted fifty-five years ago. They looked worn out and yet were no larger than many in the Valley at fifteen years of age. The old man's grove has ceased to pay its way and its future is very dim.

Non-Cultivation

In company with an Experiment Station man and an Australian whose purpose was the same as mine, I visited groves where non-cultivation is practiced. It is already quite prevalent in California and is increasing. Its users have small ditches sloping in one direction, three to five between tree rows, and down them water flows slowly to give time for penetration.

The ground is sprayed with oil to kill all semblance of cover growth; any weeds are dug out with a hoe. In other words, growth between the trees seems to be regarded as a hundred percent enemy of the effort for good production. To a Valley grower accustomed to use cover crops as soil builders, this looks like death to soil fertility. One of its bad effects is that it causes lady bugs, enemies of scale to leave the groves.

The practice is to spray two to four times a year to kill scale, and you are told that in two to four years the scale becomes immune to the more moderate oil sprays; then these are strengthened to an extent that kills twigs six to ten inches long all over the tree.

Little Luck with Resets

In reply to a question about resets an Experiment Station man said, " well, when we take these old trees out we don't have much luck getting resets to do any good." I repeated this to a citrus grower who was introduced to me as an expert, and he answered, "Thats right. I had an old grove that was so badly frozen in 1937 that I took all the trees out and replanted the whole grove. For three years I struggled with the trees without satisfactory results, and sold them. I saw them when they were ten years old; they were far from up to standard. My conclusion was that the main reason for this failure was soil exhaustion.

Causes of Soil Exhaustion

In the earlier days of California citrus growing the soil had sufficient fertility to produce good trees and sizeable, excellent fruit. Many growers grew cover crops of legumes, mostly in the winter because in the summer there was a lack of water. A grower's comment to me was, "We don't have enough water in the summer to support both a cover crop and the trees. The only way we can grow citrus fruit successfully is by using nitrates." This is a general belief.

Anyone desiring to know why synthetic nitrates destroy soil fertility will be repaid abundantly by writing to *Organic Gardening*, Emmaus, Pennsylvania. Buy this monthly magazine at $3. a year. But an even more comprehensive and needed publication is a book by Sir Albert Howard, obtainable at $3.50

at the same source. Here you will find analyses which space limitations do not permit in this article. Also, definite formulas for making compost are given in the book, which will put you on the road to proper soil building. For this you will be grateful if you are a tree culturist who aims to grow citrus for later years or for prosperity.

California citrus producers grew cover crops for a period but now have reverted to the non-cultivation, nude soil system, a system that yields fruit but is conducive to rapid decline in quality and quantity of production, while at the same time multiplying difficulties and expense in fighting enemy organisms such as destructive insects.

Mistake of Valley Growers

Under my observation and that of others here in the Valley have come very damaging effects of the use of synthetic nitrates, the chief offender being ammonium sulphate. When used in successive years, especially in the winter, to hasten fruit growth, it is largely responsible for heavy freeze damage such as that of late last January. Much of this damage occurred on the Valley's best citrus land.

Organic Soil Building

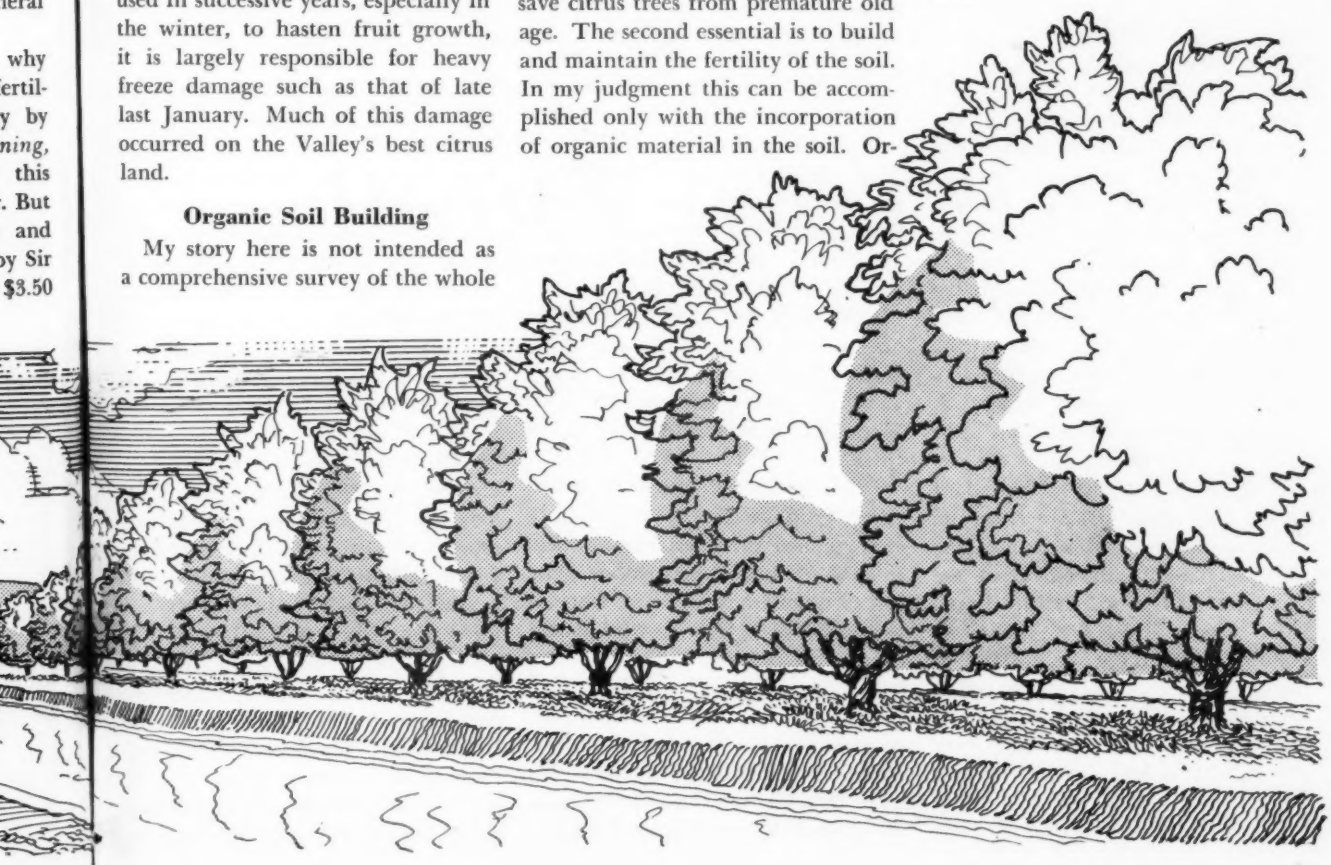
My story here is not intended as a comprehensive survey of the whole range of organic culture, but to outline a system by which I have obtained notable results within a very few years. The system is called Organiculture. My groves are now nineteen and twenty years old. I am often asked how long citrus trees can be maintained in good production. I think no one knows. Many thousand acres in California have been producing satisfactorily for fifty-five years; some have retained considerable vitality up to eighty years, with remnants holding their own to some extent at a hundred years of age. I think it is safe to say that the passing out of citrus trees at relatively early ages is due to periods of neglect because of prices too low for a profit, and to mistaken practices in general. These factors lack much of indicating how long a grove can be maintained in healthy production.

The first essential here in the Valley is deep drainage. Salt water must be kept below the root system to save citrus trees from premature old age. The second essential is to build and maintain the fertility of the soil. In my judgment this can be accomplished only with the incorporation of organic material in the soil. Organic material is anything that grows from the soil.

Soil Building with Sheet Composts

Many materials can be used for sheet composting. Experiments, mainly in India, have resulted in doubling average production and greatly improving the product. However, my purpose in this article is to describe specific practices by which I have obtained substantial results here in the Lower Rio Grande Valley.

On groves with an average age of nearly twenty years I have been installing drainage for about twelve years, and now have an almost complete system of tile drains having an approximate depth of ten feet. (Shallow drains will not do the job.) Where I formerly lost something like half my trees through seepage and salt I now have thriving trees which produce heavily right where the old ones were removed. Today I do not have a yellow tree on 140 acres.



Increasing Citrus Vitality

Continued

Sprinkler Irrigation

I was using the flood system of irrigation up to the first of 1948. Irrigation by this system requires borders, which may destroy as much as half a cover crop in a grove of large trees. For this reason I began in 1949 the use of the sprinkler system, which permits a solid growth of cover crop and mowing the native growths after clover is disced in. I have concluded definitely that this is the better way to irrigate. However, when there is not a good rain sometime during the season it is difficult to provide enough water for the deep roots, and heavy expense is involved in supplying sufficient moisture. The sprinkler system is decidedly advantageous on land with a high water-table. The application of surface water from the sprinklers tends to cause the water-table to recede.

Cover Crops

For three or four years I have grown a hubam clover crop, which this year, 1949, has been luxurious. It develops considerable humus and nitrogen in the soil. This in turn produces a strong growth of Johnson grass and careless weeds after discing the clover into the ground in May and June. This native growth has been persistent and plentiful. The crop was mowed three times from June to October. The result was a compost sheet of humus, which was disced under late in October. The growth on the ground when the clover was disced in was so abundant that I was afraid to leave it on the surface. The fire hazard caused me to put it under, though from the viewpoint of true soil culture I consider it best to let the growth accumulate. But the wisdom of avoiding the fire danger was shown when we stopped a fire on a neighbor's land only twenty feet from my groves, after it had burned through his.

Thus it will be seen that we have put into the soil a great deal of humus material, which is said authoritatively to contain some of all the valuable elements needed by citrus trees. This summer a citrus feed mill burned in McAllen and we hauled and spread through the clover and native growths some four tons an acre of citrus peel feed. This went into the ground with the clover. Any other kind of organic matter would have been good for the purpose. On fifteen acres in January, 1949, I placed twenty tons of manure per acre.

Results of Abundant Humus

It is a well established fact that high water-tables and salt concentrations seriously lower the vitality of citrus trees, and those handicapped by these conditions were severely damaged by the freeze late last January; many were killed outright. But previous drainage had taken the salt well out of most of my groves before the freeze. However, old trees growing where reclamation had not been completed suffered much injury. This was in contrast to the effect of the freeze on old trees located where soil fertility had been conserved. A substantial percentage of these, having the advantage of drainage that had been in long enough, produced an especially heavy crop, and many trees required no pruning at all after the freeze had passed. One block had about a ton of fruit to the tree.

I am fully convinced that the cover crop treatment importantly strengthened the resistance of these trees to unduly cold weather. The soil so treated has life in it, whereas some six years ago it was hardly capable of producing good careless weeds. A comparison of the native growths on this land and those on neighboring lands is sufficient evidence of the difference in the fertility of the two. On the adjacent soils the growth is brown and dormant. In my groves the new clover crop is now several inches high, and the Johnson grass, a bright green, is waist-high and about ready to mow again. Mowing is necessary to enable the clover to get ahead of the native growths.

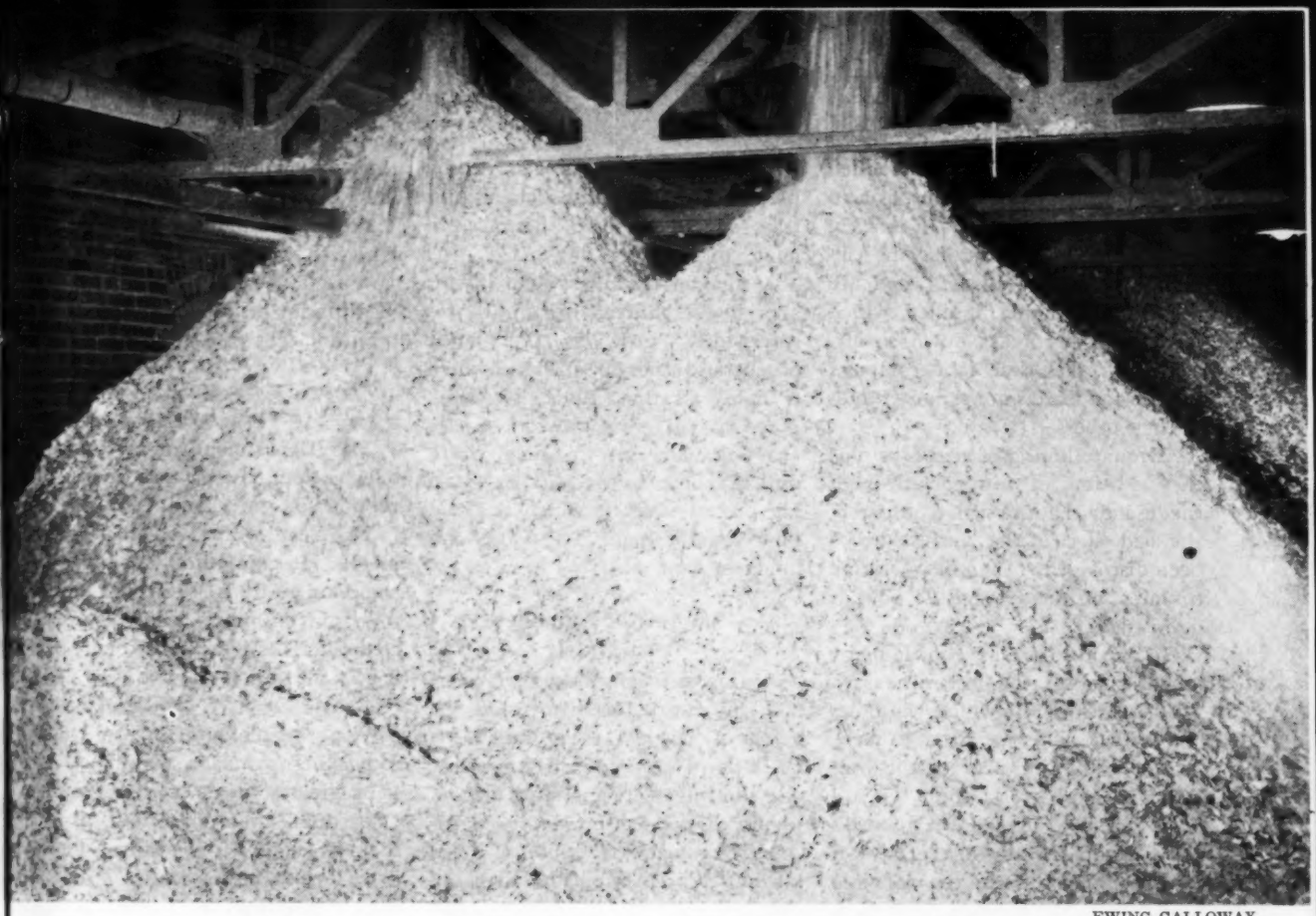
Harnessing Earthworms

Growers not aware of the value of earthworms should read a book of great interest called *Harnessing the Earthworms* and written by Dr. Thomas Barrett, whose address is Sun Valley, California. The price is $3.50. The lowly fishing worm has been serving man through the centuries, consuming large quantities of earth, mixing it with humus in the soil and converting the mixture into rich available plant food. Wherever earthworms abound crops are good. I have looked for earthworms in the Valley but have found so few as to convince me that they do not flourish here because of insufficient humus and moisture in our soils.

Recently I have set untold millions of earthworms to work at making more humus for my groves. I can dig out two to four with one thrust of a pocket knife. On the tract where the manure was placed, their castings on the surface are a sheet a quarter of an inch thick in places. It is said that earthworms thrive best in slightly acid soils. If this is so, the organic material in the ground must have changed from an alkaline to an acid inclination.

Good California Practices

My references to poor practices with the soil in California citrus groves impel me to state that a cross-section of growers there have seen the light and have adopted the organic process for maintaining soil fertility. They are obtaining great results. Through them came the information that has accelerated my study of the subject, and I feel today that I am a much improved citrus grower. I believe that I am on the right track to do something through the medium of the soil to increase soil health and hence the better health of humanity.



EWING GALLOWAY

Scout around near your farm and you may find a treasure in sawdust like this.

HUMUS FOR FREE

Weathered sawdust is a valuable fertilizer

By A. W. DOLIN

A RECENT Department of Agriculture bulletin encouraging the use of sawdust overlooks one of its most beneficial uses to the farmer, who often has an available supply somewhere in his vicinity.

"Piles left out in the weather near sawmills are practically useless," says the bulletin, "except for mixing with poison to control grasshoppers." It does add this afterthought, "Ultimately, such sawdust may be used to improve the physical condition of the soil in some areas."

It is these very piles "left out to weather" which may prove a goldmine to the farmer—right now, not "ultimately." Used as mulch, or worked through barn and poultry house with bedding and litter, sawdust adds valuable properties when returned to the soil.

One cord of sawdust has been found to contain 32 pounds of nitrogen and 39 pounds of potash. Ten percent of the minerals in hickory were found to be magnesia and 48 percent of the ash of ash trees was potash. It stands to reason that sawdust must contain valuable trace elements (whose importance is recognized but about which so little is yet known) which the hungry, deep-reaching tree-roots bring up from the hidden reservoirs of the subsoil. These elements become a free and natural fertilizer when incorporated into the topsoil.

There is an old notion that sawdust is harmful to crops and soils. The Vermont Experiment Station has found no harmful effects as

HUMUS FOR FREE

Continued

long as sufficient nitrogen is added to the sawdust. Raw sawdust is acid reacting, although as much as 25% of its mineral content may be calcium. The cell walls of wood are more or less highly lignified, which means that it breaks down slowly, as lignin takes time to decompose. Some wood breaks down more rapidly than others.

Adequate liming of acid soils plus the addition of nitrogen through the use of manure will counteract the acid effect of the sawdust, it has been discovered, (a ton of cow urine contains, on the average, 25 pounds of nitrogen).

On our farm, we have made many ten-mile jaunts for free pine sawdust at a saw mill which welcomes our arrival. This we use in a heavy layer on the dirt floor of the beef cattle barn. Bacteria from the soil begin its slow breakdown immediately, while the sawdust acts as a sponge which absorbs the valuable liquids from the manure. It is these liquids, so high in mineral content, which usually are lost before manure can be returned to the soil.

On top of the sawdust goes the usual straw, mixed with leaves from the giant maples of our front lawn. This bedding, with an occasional sprinkling of sawdust, is built up all winter in the barn. The trampling of the cattle and the action of the soil bacteria make the great mass a partly decomposed fertilizer, ready for sheet composting in the spring.

We use the same process in the poultry house, although the floor is concrete. Pine sawdust is especially useful as litter as it is the most absorbant of the available sawdusts. The Vermont Experiment Station found that one hundred pounds of the bedding will hold 545 pounds of moisture. Woods from moist soils, such as willow, are apt to be richer in minerals than those grown in dry soils. Willow also breaks down easily as there is no resin to slow up bacterial action. Walnut trees seem to have a poisonous effect on nearby plants, so that sawdust from walnut trees should be used, perhaps, in moderation.

A commercial nurseryman in this area (who gardens organically) is successfully growing berry-laden blueberry bushes on sandy soil which is highly alkaline. Blueberries, supposedly, will grow only in strictly acid soil. His only treatment is to mulch them heavily with sawdust. He prefers sawdust which has had some weathering. His plants are much in demand.

Sawdust Is Valuable As a Mulch

An increasing number of farmers and gardeners are discovering the value of sawdust as a mulch. It keeps down weeds, absorbs moisture, and controls the temperature around plants. *Organic Gardening* Magazine recommends the use of fresh sawdust for covering the drills of radishes, turnips, and other members of the mustard family a few days after the seeds have been sown. A very thin covering, it says, will discourage the growth of annual weeds which can be most annoying among the young seedlings.

A sawdust mulch is excellent for strawberries, although care must be taken not to cover the crowns. Raspberries, some find, do better with a leaf mulch than with sawdust. It has been used with fine results, however, around pears, plums, apples, peaches, grapes, currants and gooseberries.

Sawdust makes a sucessful winter mulch also, insulating the soil and plant roots against alternate freezing and thawing. It is particularly useful around rose bushes.

Sawdust left on as mulch gradually decomposes and becomes incorporated into the soil. Authorities agree that it is better not to work raw sawdust directly into soil which is to be used immediately for growing plants, as it may take too large a supply of bacteria away from the young rootlets. (Adequate nitrogen and organic matter in the soil through generous manuring will help overcome this).

Prof. MacAndrews of Syracuse University, however, has found fresh sawdust to be a satisfactory seeding medium for primula and hybrid delphinium.

Sawdust, Versatile By-Product

The Department of Agriculture offers a long list of uses of the by-product of the sawmill. It is used in dry cleaning fur and in finishing metals. It goes into floor-sweeping compounds. It is stuffing for dolls, toys, pin cushions, tailor's pressing compounds. Made into wood flour, it goes into linoleum, explosives and plastics. The fresh sawdust of hickory, oak, maple, and birch are used in packing plants for smoking meats.

Its greatest use, according to the Department of Agriculture, is for fuel. Specially designed furnaces use it to furnish power for sawmills, or to heat buildings and homes. A fuel which is growing in popularity (with the increase, perhaps, of coal strikes) is sawdust compressed at high temperatures into briquets.

The Forest Products Laboratory has made molasses suitable for cattle feed from wood waste and may be able to make it from sawdust.

"The great difficulty in using sawdust is that the supply is not concentrated at central points near possible markets but is scattered all along harvesting and production lines from forest to sawmill to factory so that collecting and shipping is too expensive to be profitable." So says the new bulletin.

This very "difficulty" is the farmer's advantage, as most farms are situated somewhere near a sawmill which is happy to have its growing piles depleted without effort on its owner's part. Working the sawdust back into the soil of the very area from which it came is a boon to the farmer as well as an important step in long-term soil conservation.

LEGUMES

Nature's nitrogen gatherers are the farmer's best friends

By M. B. CUMMINGS
Vermont Agricultural Experiment Station

Photo by Soil Conservation Service

PLANTS vary much in their ability to build up the fertility and the organic content of soils. The amount of gathered nitrogen, for instance, may equal 250 pounds per acre in some cases and very little in others. Hairy vetch may contain when decayed three to four per cent of nitrogen; on the other hand buckwheat when plowed under and decomposed, adds but little nitrogen. Even among the legumes there is much difference in their value. Moreover, the different clover species vetches and related plants show distinct advantage in soil building capabilities.

Legumes are able to grow on poor soil devoid of nitrogen,—where other types of plants may fail, provided the bacteria are there, and other conditions are favorable. In this way legumes when left in the soil increase the nitrogen content. Many species are described in this article with brief suggestions on how to use each one, together with its soil and climatic preference, and how and when to seed them. This is for the purpose of giving a country-wide

A twenty acre pasture of lespedeza and white dutch clover that supplies pasture to one animal unit per acre throughout the year.

HUMUS FOR FREE

Continued

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Crops

LEGUMES

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By M. B. CUMMINGS
Vermont Agricultural Experiment Station

Photo by Soil Conservation Service

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Legumes are able to grow on poor soil devoid of nitrogen,—where other types of plants may fail, provided the bacteria are there, and other conditions are favorable. In this way legumes when left in the soil increase the nitrogen content. Many species are described in this article with brief suggestions on how to use each one, together with its soil and climatic preference, and how and when to seed them. This is for the purpose of giving a country-wide

A twenty acre pasture of lespedeza and white dutch clover that supplies pasture to one animal unit per acre throughout the year.

BEFORE: An eroded field that is almost a complete loss.

LEGUMES *Continued*

picture of the possibilities in the use of leguminous crops in producing soil fertility.

Nitrogen gathering plants are excellent in organic farming. The species in this group are often called leguminous plants for they bear their seeds in legumes or pods as in vetch and clover, in peas and beans, and in many similar plants. The word legume also comes in part from legumen, a protein-like substance stored in the seeds of legumes. In the roots of these plants are root-inhabiting bacteria (Rhizobium and Pseudomonas) which are species of minute organisms which live in little nodules. These bacteria have the capacity to take up some of the large amounts of free nitrogen of the atmosphere and transform it with chemically combined nitrogen used by the plant. The plant furnishes starch and sugar for the bacteria, and in turn receives nitrogen for itself and for the soil. On the roots of legumes are found little nodules or gall-like structures wherein are the beneficial bacteria.

Soil rich in organic matter may contain millions of helpful bacteria at the surface, and by placing these in the soil where needed, the land becomes inoculated. All legumes leave the soil richer upon decay because nodules contain bacteria and nitrogen which remain in the land after the crop is gone. Fully grown legumes plowed under may add 100 to 200 pounds of nitrogen per acre, equal to nearly $40 worth of purchasable nitrogen. The amount of nitrogen gathered depends much upon the species. It may equal 250 pounds per acre as a maximum; an average of 122 pounds for all legumes from 16 experiment stations is reported. But to yield this amount the plants must be fully grown, preferably ready or just past blossoming. Allowing the plants to grow to large size is the easiest and simplest way to insure the organic matter in the soil. At the last stage of growth plant material is manufactured at a fast rate and in two weeks may increase 30 per cent or more. So it is important to let the plants grow to full maturity to get the maximum benefit.

Why Nitrogen is Important

This element is one of the most important in plant nutrition. Nitrogen is used in tissue construction and in stature growth. It goes into the cells of the plant body. It is used more largely than any other mineral in plant growth. Moreover, nitrogen is troublesome because it is expensive to buy. It is also highly leachable and therefore easily lost, as it dissolves readily and may leach away in soil water. No large amounts are permanently stored in the soil, but may accumulate within the stems till spring.

It is, therefore, clear that any plant that can gather nitrogen at no cost is an important one to grow for building soil fertility. This principle gives us a basis and background for building and maintaining a soil fertility program. It is well to practice this inexpensive system of enriching the land. The amount of soil derived nitrogen is subject to much variation from week to week.

depending much on the weather, but in total it amounts to a lot in a season.

Nitrogen Gathering Species

Alfalfa, also called lucerne, is a great forage crop and is an important soil improver. It has deep and wide root systems and has large nitrogen gathering capacity. A single root of alfalfa may extend 20 feet in one direction in loose soil. Seeds of it may be sown in the spring or in midsummer and grown throughout the current as well as the following season and plowed under when desired at full growth. It may persist for three or more successive seasons under favorable conditions. But the soil should be limed and inoculated, if not set already with the bacteria. Alfalfa is low in lime requirements.

Most farm animals will eat alfalfa, but it is worth much to plow under. Even if cut and removed, the stems, crown and roots will benefit the land it grows on. Alfalfa does not do well on poorly drained land, on stiff clay, or on windswept areas, for under these conditions it is likely to be winter-killed and short-lived. It is important to use well situated land for this crop.

Crimson clover is a winter annual, and mammoth red clover a biennial. Either may be sown in late summer and will give good results when plowed under, but both are beneficial to the land even if cut as hay and taken away.

Biennial white sweet clover, cowpeas and soybeans, all require a longer time to grow to full stature but make good organic matter and enrich the soil with nitrogen. This clover is weakened by severe winters. It should be seeded 15 pounds to the acre and sown in July. It is a strong growing plant.

Hairy vetch is a good legume for improving the land. It makes a good cover for the land for winter. With a good stand it gives a fairly good quality of organic matter. It is high in nitrogen, containing from three to four per cent until the middle of June. Thirty pounds are required when seeded alone. It may be allowed to ripen its seed and thus become self-sown. Inoculation is often necessary. The seed-bed should be well fitted for a good stand.

AFTER: Kudzu has restored this field to usefulness in two years.

Other Species

Several other legumes of rather recent origin and as yet not much used should be listed. They are being tested now and seem to have value.

Lespedeza makes a permanent crop, even though an annual. It is also listed as Japan clover. Early spring sowing at 25 pounds to the acre is desirable. Owing to its thick stand it makes a good ground cover. It spreads and grows thick, but is not tall. It is not a rank grower but does well in the south. If rank weeds come in, a midsummer mowing is necessary. Lespedeza grows freely in California and in the southern states.

Crotalaria (rattlebox—loose seeds in an inflated pod), especially the species *spectabilis* and *stricta,* are used in the south. They are annual growing and six feet tall. Sowing is at the rate of 20 pounds to the acre. This species is well adapted to sandy lands.

Sesbania is a North American, hairy plant, much used as a green manure crop in the southern states.

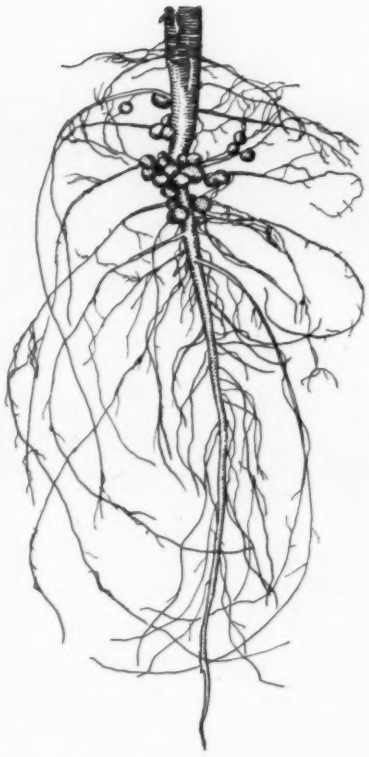
LEGUMES *Continued*

It will grow as far north as mid-Ohio. It is tall and smooth with linear pods and many seeds. It is seeded at 20 pounds to the acre and does well on muck land. It is an annual plant and will grow in moist land.

Soybeans are excellent for improving the physical texture of the land and for incorporating organic matter. This species is fairly tolerant of acid conditions, but not to strongly acid land. The rate of seeding is two bushels per acre, shallowly disced in in early summer. A yellow seeded variety, Manchu, is much used. The cowpea comes from Asia and is handled much as is the soybean. This species does not do well on poor soil. It is sown five bushels to the acre. It grows rapidly and should be cut before the pod opens if turned under. It is much used in the south. An analysis of the entire plant shows it to contain two per cent nitrogen and one and a half per cent potash. A ton of cowpea hay may contain 40 pounds of nitrogen and much organic matter.

Wild white clover, often called a weed, is being tested. It should not be suppressed but cut and saved for mulch or plowed under. Where abundant the seed may be gathered and sown. Dwarf white clover, replacing the white Dutch strain of the lawn is good for improving the soil of the lawn, but it is of short duration.

Ladino, mammoth white clover, came from northern Italy and the Pacific northwest. It was introduced in 1912, but is still but little known. It is a large species exceeding the size of most clovers. Its leaves are large, it has long stems, and a pendent habit of growth, so that it competes well for light as it has large leaves. It is being used for pastures, but will not stand close grazing because its large stems and fleshy runners are easily injured and will not stand the trampling of grazing stock. However, its long runners do not form a close turf and recovery is slow after being fed down. It is, however, a good forage crop and improves the land while growing. Ladino is fairly persistent, but generally disappears at the end of the third year. It outyields other clovers such as alfalfa. It is often called the "giant" clover.



The small, round nodules on this soybean root hide the secret to the legume's nitrogen gathering efficiency.

Bakhara, a white sweet clover, will grow on soils too poor for alfalfa. It gives new life to soils and has deep roots.

Alsike clover is very hardy and has been used for some years for forage. It is excellent for bees and enriches the soil, adding nitrogen.

Medium Red clover will grow in a variety of soils. A covering of snow in winter helps. It is a soil builder, but tends to run out after the third year. It is spreading and hairy and has purplish or whitish heads.

In conclusion it may be stated beyond the range of preadventure that leguminous plants are the premier ones for soil building purposes. This is true even though the crops are cut and removed. This advantage is due in part to the wide foraging of roots, especially of alfalfa and wild sweet clover, but largely it is due to the nitrogen gathering function due to the presence of nodules and the bacteria contained and working within them. The latter is the paramount advantage of legumes.

In buying seeds of any species of legume it is not enough to merely order alfalfa or cowpeas, for one should get the variety adapted to his section of the country. There are winter hardy, as well as arid and heat resisting forms which are especially bred for different regions. Select them with care.

To get the maximum benefit from a leguminous crop it should grow to full maturity, even if cut and removed, as the maximum intake of atmospheric nitrogen is not attained till the flowering and fruiting stage. The last few weeks of growth nitrogen intake is large.

A strongly acid soil is not favorable to legumes. The more organic matter there is in the soil the better the legumes will grow. But some species like alfalfa will build up infertile soils, when some other crop may fail to do well. Alfalfa is strategic in this respect.

And finally, let it be noted that there are superior varieties within many species of legumes. Some are better in quality, in rate of growth, etc.; others are better adapted to special districts with climate soil adaptations, a story too long to detail here. But in brief it may be noted that for alfalfa there are twelve or more varieties—Arabian, Baltic, Canadian Variegated, Grim, Minnesota Grim, Hardigan, Ladack, Peruvian, Sand Lucerne, Siberian and, the most cold resistant of all, Turkestan. State colleges will advise on local selections. A covering of snow in winter is desirable for all varieties.

How to Plan an Orchard

Keep a clear head and a green thumb when starting your trees

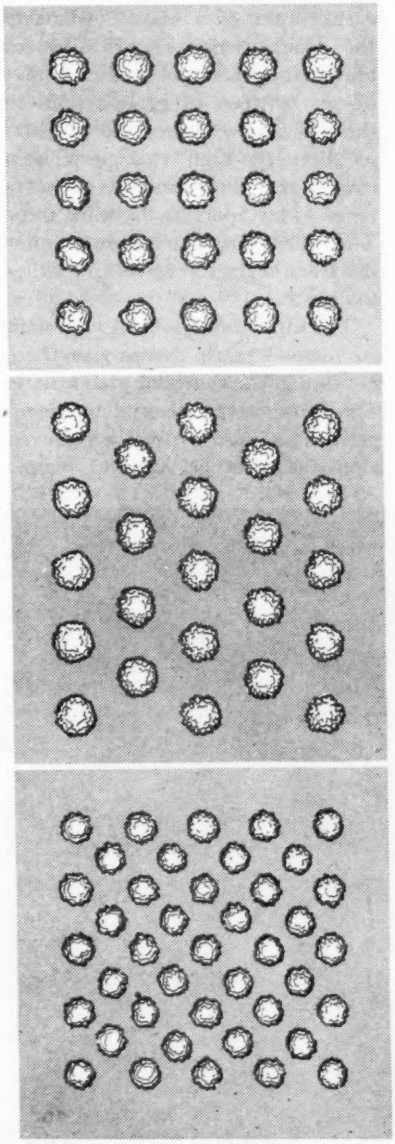
By WILLIAM ACKERMAN

FRUIT growing success is not achieved easily or blindly. If the venture is to be enjoyable and profitable, planning and sound judgment followed by prompt and effective action is necessary. The *first* step in establishing an orchard may well influence the *last* one, so be sure you are doing the right thing when you start out. Of prime importance in successful fruit growing is the proper selection of the orchard site, discussed in last month's issue. Not less in importance is the selection of nursery stock, procurement of varieties that are best adapted to your particular climate and soil and the proper arrangement, spacing and planting of these varieties.

Fruit trees may be planted in the spring or fall. In the milder parts of the United States where minimum temperatures are not likely to go below 0° F., they may be planted in the late fall before the ground is frozen. Peaches, apricots and other tender fruits often suffer considerable winter injury in more severe climates and should therefore always be planted in the spring. Spring-planted trees should be set as early as the ground will permit.

Buying Trees

In buying nursery trees it is safest to purchase from a firm of known honesty and reputation. There is some advantage in giving preference to reliable local nurseries where transportation charges are less and there is less likelihood of delay in transit with consequent drying out or freezing of the plants. However, these points should not outweigh the advantages of receiving good trees wherever they may be obtained.



Orchard planting patterns: Top, the "square" system; middle, the quincunx system; bottom, the hexagonal system.

Nursery catalogues usually list several grades of trees according to height and caliper of tree. The age of trees is also stated as one year old, two years old, etc. It pays to buy the better grade larger plants of a given age. Three year old trees are sometimes offered for sale, but the younger trees are much more easily established. For the average individual, one year old trees are the best buy. They withstand transplanting better, start growth sooner and often are inherently more vigorous.

Most large nurseries dig their nursery trees in, in the fall and store them over winter. Any reliable nursery will have sufficient sales to unload their stock without lowering the sales prices appreciably. Therefore, beware of so-called "bargains." Such trees may have been winter injured, dried out from warm storage, or have frosted roots. It is often difficult to detect these injuries until it is too late.

When you receive your trees from the nursery, be sure they do not dry out at any time before planting. If

How to Plan an Orchard

Continued

not planted at the time they are received, the trees should be heeled in. Select a place that is protected from excessive exposure and where the soil is well drained. Dig a trench deep enough to accommodate all the roots, throwing the soil in a mound along the south side of the trench. The boxes or bales in which the trees were shipped should be opened or heating may occur within the package and the trees injured. Cut the bundles and separate the trees from each other somewhat, making sure that the varieties are separated so they may be distinguished later. The trees should be placed close together in the trench row and slanted toward the south to prevent sun injury. Fill the trench with soil being sure all the roots are covered. Trees heeled in this fashion may be held for a considerable length of time before they are permanently planted in the orchard.

Spacing the Trees

Assuming that the location of the orchard has been determined, a plan must be decided on for the arrangement of the trees. Orchard trees are generally planted according to some definite system. The three most common arrangements of trees in an orchard are the square, the quincunx or diagonal and the hexagon or triangle. Where the land is rugged and steep a fourth system, the contour arrangement, is best.

The "square" system is the usual plan in most sections and makes orchard operations easy to handle. In this arrangement a tree is set in each corner of a square, whatever the distance may be. If filler, or temporary trees are used one may be set between every two trees in the row and another row of fillers set between each two permanent rows so that the permanent trees are twice as far apart as the filler trees. The filler trees are removed after the trees begin to crowd each other too much.

The quincunx system is very similar to the square, except that there is a tree in the center of each square. The center tree is considered semi-permanent and is usually removed after the trees become very large. This method is particularly desirable when alternate rows are planted to different varieties. Generally more fruit can be produced over a longer period of time since a larger number of trees can be planted to the acre. A disadvantage is encountered with this system however, since cultural practices must be carried out on the diagonal.

When the hexagonal system is used all trees are equidistant from each other and a calculated 15% more trees can be planted to the acre than with the square system.

The contour system is the most feasible arrangement for planting an orchard on a hillside. In contour planting on sloping land, all trees in any one row are in the soil at the same elevation. Obviously, the tree rows will not be equally spaced in all parts of the orchard.

The first step in laying out a contour planting is to decide upon a minimum allowable interval between rows. This distance will depend on the kind and varieties of fruit trees planted. The first contour line should be laid out at the highest elevation. From a given point, the line is projected on the

CONTOUR PLANTING IS OFTEN RECOMMENDED WHEN ORCHARDS ARE PLANTED ON EROSION-PRONE SLOPES.

contour in both directions to the limits of the area to be planted, by using an engineer's level and rod. Then proceed to the steepest slope in the orchard below the first line and establish a point at the minimum distance between rows below the first line. A line is then projected in both directions from this point in a similar manner as that in establishing the first line. If at any place in the orchard the distance between two adjacent lines becomes twice the minimum interval, a new line is laid out on the contour between them.

Distance Between Trees

The planting distance must be determined principally by the size the trees are likely to attain at maturity. This is largely dependent upon the type of fruit, the variety, fertility and depth of the soil and amount of rainfall or available moisture. The trees must be sufficiently far apart to allow the sun to hit the lower branches if fruit of satisfactory quality is to be grown on the lower parts of the trees.

Although the matter has never been definitely settled the following distances are most frequently used:

Fruit	distance in ft.
Apple	32 to 45
Pear	25 to 35
Apricot	20
Peach	20 to 24
Plum	20 to 24
Cherry, sour	24 to 30
Cherry, sweet	25 to 30
Quince	18 to 22
Dwarf trees	10 x 10
	10 x 15
	15 x 15

The variation in the planting distances for each type of fruit is largely dependent upon the variety. This can be illustrated in the example of apples. Vigorous apple varieties, such as Baldwin, McIntosh, and York Imperial, planted 25 feet apart in fertile soil, may crowd when only about 15 years old; planted 30 feet apart they will usually crowd when about 20 years old. Less vigorous trees such as Rome Beauty, Winesap, and Golden Delicious, planted 25 feet apart, would not crowd seriously until 18 or 20 years old.

Arrangement of Varieties

Pollination refers to the transfer of pollen from the anthers to the stigma of a flower. Self-pollination refers to the transfer of pollen from the anthers of a flower of one variety to the stigma of a flower of the same variety. Self-unfruitful, in the strict sense, means the inability of a variety to produce fruit with viable seeds following self-pollination, while self-fruitfulness involves the production of fruits with viable seeds. Cross-pollination refers to the transfer of pollen from a flower of one variety to a flower of a different variety. If one variety, when used as the pollinizer of another, is unable to produce sufficient fruits for a commercial crop, the two varieties are considered cross-unfruitful toward each other; if fruits are produced, cross-fruitful. Most of the fruit types display rather definite patterns of self- and cross-unfruitfulness among the different varieties.

Some fruit varieties are sufficiently self-fruitful to be dependably productive if planted alone. However, for the individual who is not familiar with self- and cross-unfruitfulness among fruits, it is the best policy to plant several varieties of each fruit to be grown. Orchard observations and experimental results indicate that to obtain the most dependable set of fruit, trees of different varieties should not be further apart than two rows for the larger fruits, such as apple; or not more than 80 to 85 feet from pollinizer varieties.

The value of a pollinizer, other than the ability of its pollen to fertilize the flower of other varieties, depends on several factors. Certain combinations of varieties are not fruitful because their blooming seasons usually do not overlap sufficiently. Certain two-variety combinations may be unfruitful because of the difference in age at which they form their first flowers. Also combinations that consist of annual and decidedly alternate bearing varieties will not produce full crops year after year. The use of a third variety in such cases to supplement the pollination of the annual variety will remedy the situation. The most frequent reason for failure of cross-pollination between varieties is their close relationship. The unfruitful combinations in most instances comprise of a variety and its bud mutation or "bud sport."

Here is a brief summary of some general rules to follow in planting different types of fruits:

Apple Pollination tests have shown that cross-pollination is essential for a full commercial crop. It is now generally conceded that all apple varieties should be interplanted to insure the production of high yields.

Pear All varieties of the European pear and those of hybrid origin, such as Keiffer, have been found to be self-unfruitful.

Quince Most quince varieties grown in United States have been found to be self-fruitful.

Peach The greater proportion of tested varieties are self-fruitful and may be planted in solid blocks of one variety. Probably the most notable exceptions to this are the self-unfruitful varieties J. H. Hale, Hal-berta and Pacemaker.

EWING GALLOWAY

SLOPES.

Nectarines and Apricots All varieties of these fruits tested have been found to be self-fruitful.

Cherry All sweet cherry varieties tested have been found to be self-unfruitful. Practically no fruits at all are obtained through self-pollination. Not only does self-unfruitfulness exist, but many varietal combinations are unfruitful, since there is considerable cross-unfruitfulness between varieties.

Sour cherry Self-fruitfulness exists for such varieties as early Richmond, Montmorency, Dyehouse and the Morello group. The varieties Chase, Homer, and Ostheim have been found to produce only a small set when self-pollinated and should be interplanted with other varieties of sour cherries.

Plum The European plum exhibits a rather wide range of differences in the response of its varieties to set fruit through self- and cross-pollination.

If fruit types are planted that exhibit degrees of self- or cross-unfruitfulness, as indicated above, it is a good policy to examine the nursery catalogue well before choosing the varieties you wish to plant. If the catalogue does not indicate the fertility relationships to your satisfaction, inquire about the compatibility of the fruits when you place your order.

Planting the Trees

When the hole is dug for planting the tree, the top soil should be kept separate from the subsoil. If practical, mix some compost with the topsoil and throw this in around the roots when the trees are set. The soil and compost should be well distributed around the roots and packed closely by tamping to insure that no large air spaces are present. Be sure the tree roots are kept moist during the planting time. Never allow the roots to be exposed to the sun for more than a few minutes. For best results the trees should be set about two inches deeper than they were in the nursery. Where water can be added after planting it is a good practice for giving the tree a start and settling the soil.

Poultry

Less Cleaning for Bet

WHAT does sanitation mean to you? Perhaps it brings to your mind a picture of stainless steel and glass, of white-coated attendants and the odor of disinfectants. If this were your idea, how would you apply it to your poultry flock? Probably you would imagine each hen or chick in a glistening cubicle, the interior constantly awash with automatic sprays of antiseptic, lighted by germ-killing rays from an ultra-violet lamp.

All this sounds quite fantastic doesn't it? Yet it would be the ultimate goal of those who act upon the idea that since bacteria are bad, their duty is to isolate chickens from all sources by which these death-dealers might come to them. Some poultrymen seem to have set out on such a course of action. If you visit their farms, you may be invited to step into a vat of antiseptic foot wash before entering the chicken house, or to wipe your shoes on a mat soaked in similar solution. These folk may change shoes several times in the course of a day's chores in traveling from one flock of chickens to another.

These people do not claim to be willing slaves to chickens or devotees of unreasonable custom, but rather that they are doing the scientific thing in protecting their flocks from disease. At the same time other poultrymen are using bacteria to do the work of sanitizing poultry houses and keeping disease in check.

Good News From Ohio

At the Ohio Agricultural Experiment Station thirteen successive broods of chicks have been raised on built-up litter without cleaning the brooder house. In view of the increasing health and vigor of each succeeding flock, the good word from Ohio is now that poultry house cleaning is merely a matter of keeping the floor litter within reasonable bounds. If you choose to put an extreme definition upon "reasonable bounds", you might clean the brooder house only when your head is in danger of bumping the rafters.

Built-up litter at this experiment station has helped in effective control of coccidiosis and cannibalism among chicks and increased hatchability of eggs. All these good results were accompanied by lower labor and feed costs.

When the manpower shortage during the war reduced the number of workers at the station, the usual practise of cleaning and disinfecting the brooder house after each flock of chicks was discontinued. Instead of greater losses by disease as expected, fewer chicks died because coccidiosis was noticeably reduced.

Litter Controls Coccidiosis

Carefully controlled experiments were then set up to check this method of coccidiosis control. Results over a period of years have shown that built-up litter is accompanied by less coccidiosis. An excerpt from a recent report from the experiment station reads as follows: "Seldom did a brood escape an attack of coccidiosis *before* the use of built-up litter. *Afterward* there was no noticeable trouble from coccidiosis in eleven consecutive broods started and raised on the same old built-up litter."

During a three-year period when litter had been removed at frequent intervals, the average death-rate among 18,000 chicks was 19%. During a corresponding period on built-up litter, with a total of 10,000 chicks, the deaths dropped 12%.

By THOMAS E. JOHNSTON

for Better Sanitation

Most poultrymen know coccidiosis all too well, recognizing the symptoms of droopiness and bloody droppings which precede death to a percentage of all those affected. Many controls have been suggested and tried, none of them fully successful. If the Ohio findings had done nothing more than find this effective and laborsaving control of coccidiosis, that in itself would have been a welcome advance in poultry keeping.

Dr. D. C. Kennard and his associates, however, investigated litter management further to determine whether built-up litter could have any relationship to poultry feeding. Now after a period of controlled experiments using simplified rations and comparing growth of chicks from birth to maturity, they have found definite advantages in favor of built-up litter.

Simplified rations which chickens have been fed, have consisted of a basic all-plant diet, from which all meat scraps and whey have been eliminated. These rations are described as "severely deficient" in vitamin content and in animal-source proteins. Chicks and laying hens have both done as well on these restricted rations as others have done on rations which are fully fortified with vitamins and animal-source proteins, as long as the chicks receiving the simplified diet were on old built-up litter.

In experiments with laying hens, likewise fed a simplified diet, the hatchability of eggs has held up when the hens were on built-up litter.

How to Build Up Litter

A deep or dry litter is not necessarily a built-up litter. In producing this condition, the requirement is similar to that of a good compost pile or of sheet composting in the field. Starting with several inches of absorbent litter material, the person who produces a satisfactory built-up litter will stir the litter to keep it in a loose condition and add lime and new material from time to time as needed. At the Ohio experiment station hydrated lime was used, at the rate of 10 to 15 pounds per hundred square feet of floor space. This has been applied at intervals of from two to four weeks, or longer depending upon conditions. Although no trials have been reported using ground limestone, it seems likely that similar results might be expected. An essential feature is the thorough mixing of lime through the litter, stirring it, and adding new litter as needed.

This method proves of special interest to organic farmers for several reasons. In the first place, from a practical point of view, it is a process which has been used successfully on farms as well as on experiment stations, with desired results and lowered costs. Then there is the value of getting the manure and litter from the house in a composted form which is beneficial to plants.

Exactly why the process works as it does is still somewhat speculative. Organic farmers know the health-giving power of compost, how it promotes healthy growth of plants, which in turn transmit health and good nutrition to animals eating them. In "An Agricultural Testament" Sir Albert Howard reports that his work-oxen at the experimental farm at Pusa, India, rubbed noses with cattle infected with foot-and-mouth disease without contracting the disease themselves. Plants and animals fed organically-produced food are notably more resistant to disease than those fed on artificially fertilized crops.

Several theories have been advanced to explain the results, among them that chicks build up resistance to coccidiosis by being exposed at an early age to small quantities of the infective one-celled animals which cause the disease. Damp floors are known to promote the spread of coccidiosis, a condition which built-up litter helps overcome. Among the more plausible theories, however, is that the chemical and biological chain of events which leads any organic material to decay is a healthy and natural process.

There is a very definite possibility that this control of coccidiosis among chickens may be brought about by an antibiotic similar to penicillin or streptomycin, or one of the several others in use or being tested for use by the medical profession. Dr. Selman A. Waksman, soil microbiologist of Rutgers University, developed streptomycin from a strain of *Streptomyces griseus* found in a chicken's gizzard by Dr. Frederick Beaudette, poultry pathologist at the same university. Dr. Waksman has also grown cultures of this same species of microorganism from heavily manured soils.

Whatever cause may finally be found to explain why built-up litter acts as it does in controlling disease and supplementing deficient rations, we recognize here another bit of evidence of the workings of nature's cleansing and sanitizing agents. These agents, the bacteria, molds, and fungi of decay perform the special job of purifying wastes and converting them into products useful to other forms of life.

Those who practice organic methods of farming will find methods of keeping these useful but unseen forms alive, and devise ways in which to aid their sanitizing action. They will avoid the mistaken belief that all unseen "bugs" are carriers of death and disease, all to be killed or eluded.

How Safe Is Your Water?

Polluted water is often crystal clear. Don't let it fool you!

By JEANNE PONTIUS RINDGE

AT THIS moment, 27 million rural Americans are courting death via the water glass. Most of them are unaware of the danger. You, yourself, may be drinking water which—although your family has drunk it safely for generations—can kill you tomorrow.

The highest death rate in the country from the so-called enteric diseases—typhoid, dysentery, diarrhea, cholera, and others—is in rural areas. There is a similar shortage, in these areas, of proper sanitary facilities, according to a recent survey of the U. S. Public Health Service. "Although this is due to some extent to lack of money", the report says, "it is also due to a lack of realization of the dangers involved".

The fact that over half of the 50 million well-users in this country need new or improved water supplies indicates the problem to be one of education as well as finance. Water pollution is happening to the "best" people. You may be among them.

In this case, it is what you DON'T know that CAN hurt you! Two glasses of water sit on the table. Both are crystal clear, taste wonderful, are drawn from a well used safely for years. The water in the left hand glass will do you no harm—it was drawn yesterday. The water in the right-hand glass, drawn today, may put you in your coffin within weeks.

An extreme improbability? Not at all. It is happening much too frequently. The yearly average of waterborne diseases doubled during the period 1938-45 over the preceding 16 years. There were 316 such outbreaks during the eight-year period, resulting in 114,000 cases of illness (not counting the thousands unreported) and 84 deaths. Polluted wells were the most frequent source of these epidemics.

The remedy requires an understanding of the nature of waterborne diseases, the causes of water pollution, as well as the prevention through proper analysis of local water conditions and adequate well construction.

The "Case of the two water glasses" can best be explained by use of a true story which, with variations, will be repeated more than once in the coming months. Without proper precautions, you or your family may be involved.

August 26 and 27 were special days in the prosperous town of Gasport, N. Y. Orchards hung lush with fruit, flower beds flamed under the hot sun. Hundreds from the surrounding county flocked into the village for the two-day Flower Festival sponsored by a church.

Women toiled in the over-heated church kitchen preparing chicken and biscuits, bowls of steaming potatoes, crisp salad, apple pie for the final dinner. Hardest worker was the Festival Chairman, a woman of high standing in the community.

Five hundred people crowded the saw-horse tables for the last meal. Many others, especially the children, did not sit down to eat. They were made happy with ice cream cones, the dipper kept carefully clean in a bucket of water.

The old church pump worked overtime, cooling parched throats, particularly those of the kitchen workers. When the well went dry water was brought in from outside.

The Festival was a great success—so everyone thought. One week later, typhoid broke out in the town. Within 26 days, 86 people had the disease, followed by 9 others who caught it from some of these. 53 were children under 20 years of age. Most of the rest were women who had worked hardest to make the Festival a success. Unnumbered celebrants came down with dysentery.

Here is the surprising fact: careful investigation by the N. Y. State Health Department showed that *those who drank church water on the 27th, but not on the 26th became ill. All those who became ill drank church water or came in contact with it via the ice cream dipper.*

Two glasses of water from the same well, 24 hours apart—one harmless, the other lethal.

The church well had been used daily for years without unfortunate results. For that reason, said many, the water could not be responsible. It is this false sense of security which *is responsible* for a large percentage of the kind of typhoid outbreaks which recently struck down five members of one family in Loogootee, Indiana, 8 well-users in Washington, D. C., 7 in a Poland Village, N. Y. lumber camp, 3 in a Santa Rosa, Calif. laundry—to mention but a few.

The dread disease, amoebic dysentery, brought home from the Pacific war, is on the increase. It also is a waterborne disease which could enter your water system, if it is inadequate, in a way similar to that which brought typhoid to Gasport.

What about that Gasport well? A scientific test showed the water to be

highly polluted. In that case, why had there been no trouble before? Further investigation uncovered a series of circumstances which, on Aug. 27, meshed together in such a way that a typhoid epidemic was set off in high gear.

The well which furnished water for drinking and cooking purposes (cistern water was used for toilets and bowls) was located in the basement, ten feet from the septic tank just beyond the foundation wall. It was a shallow, drilled well, 6 inches in diameter and 26 feet deep. It was encased in concrete for 4½ feet below the floor.

Investigation showed that during a light rainfall, a slight flow of water seeped into the well at this level. Also, it was discovered that when a large flow of water passed through the septic tank (as was certainly the case at the time of the festival) it would back up through a drain tile line from the roof and seep out through an open joist and from there down into the well.

This probably had been going on for years. Illness of a mild nature may have resulted from time to time without anyone tracing it to the church well. Why the sudden outbreak of typhoid?

Germs from an enteric, or intestinal, disease, such as typhoid, come from the intestinal tract of people who have the disease and enter the intestines of those to be stricken, usually through food or water. Therefore, if anyone suffering from an enteric disease uses toilet facilities which drain into a well, the germs of that disease pass into the drinking water, causing illness in the users. Until the moment a particular enteric germ reaches the water user, the water was harmless.

Typhoid, however, has an insidious attribute. Usually, when a person becomes well of an enteric disease, he soon loses the capacity to pass it on to others. With typhoid, however, a person who has recovered from the disease may continue to incubate (in gall bladder and intestines) typhoid germs for the rest of his life. These people are called

Water to be tested is taken from the sample and placed in fermentation tubes.

Into the incubator. If sewage germs are present in the tubes, the milk sugar will be "split" when the tubes are removed.

The technician is counting the number of bacteria per cubic centimeter of well water.

How Safe Is Your Water?

Continued

typhoid carriers. Often, and usually, unknown to themselves, they are passing off germs into sewage which, if it comes into contact with food or water used by others, will spread the disease.

All victims of typhoid, today, are tested for this possibility, which can be rectified by surgery. In years past, however, typhoid was not always properly diagnosed. Many older people, therefore, have had the disease without knowing it, or without being tested as a carrier afterward.

Laboratory tests were made upon everyone who had worked at the Gasport church during the festival and had used the toilet facilities. The fine chairman of the committee was found to be a carrier. She did not know that the "extreme illness" of years before, had been typhoid. Polluted but still "safe" on Aug. 26th, the church water was filled with typhoid by the 27th.

Most old wells were not properly constructed, or, if they were, enough time has elapsed to allow for breaks or erosion. Surface water may be draining into the top of your well, also. Pollution* conditions are increasing rather than decreasing, so that the ground water, itself, may be unsafe before it reaches your well.

You cannot see germs, or taste them. Dangerously polluted water can be sparkling clear. The only way to "know" what you are drinking is to have your water laboratory tested, not just once, but at intervals under varying weather conditions. There is only a small charge for this service.

Call your doctor or local health officer and he will take care of the arrangements for you. If you are skeptical about its validity (as many people are) then follow your water to the laboratory and watch the show. It is interesting as well as convincing.

These laboratories are run by highly-trained technicians under the supervision of a physician especially qualified in this field. They work under scientifically-controlled conditions to conduct blood tests, water tests, urinalyses, and other services for hospitals, doctors, and boards of health in their area.

The lab furnishes your health officer with a special, sterilized bottle, into which he puts a sample of your well water. First, however, he pumps your well for five minutes to free it of any surface water, and then sterilizes the well vent. His hand never touches water nor bottle stopper, so there is no possibility of outside contamination.

He will explain the problem of the test in words similar to those of Dr. Joseph Tannenberg of the Genesee Laboratory in Batavia, N. Y.: "First, we must find the number of bacteria present in one cc. of your water (a cc. is less than a teaspoonful). Not all bacteria are harmful, so, second, we must find out if there is sewage in the water, because sewage can carry any of the deadly enteric germs."

The Testing Procedure Is Simple

Into a small, flat dish containing a sterile broth (which looks, and is, much like clear chicken broth) a technician puts 1 cc. of your well water (diluted with sterile water). The dish is covered with a glass lid and placed in an incubator for 24 hours. During this time, the broth forms a gelatine which immobilizes the growing bacteria colonies.

Each bacterium multiplies 25 to 30 billion times in 24 hours, making colonies which can be seen by the naked eye or under low magnification. They appear as small flecks of soapsuds in the gelatine, and can thus be easily counted.

Really pure water should not contain more than three or four bacteria per cc. Some well water, whose tests the writer observed, had counts as high as 10,000 per cc.

"If sewage is present in the water", the director will tell you, "the most prevalent sewage germs, coliform bacteria, will be there also. If we find these germs in the next part of our test, we know that other, more deadly germs, can enter your water supply at any minute".

Coliform bacteria have the power to split a carbohydrate such as milk sugar. Milk sugar, therefore, is added to more of the broth (ungelatinized). Both are placed in five sterile test tubes in the bottom of which has been placed a smaller, inverted test tube. Some of the water is added, the tubes plugged and then incubated for 24 hours.

You will see a great change when the tubes are removed—if the enemy is present. The milk sugar will be "split", forming a gas which has collected in the small inverted test tubes and turning the remaining liquid cloudy. More tubes are tested in the same way with increasingly smaller amounts of water in order to get an accurate count of the number of coliform bacteria. Still another test is made to check the accuracy of the findings.

These tests are analyzed and the director will send you a report giving you the count of all bacteria per cc., and also stating whether or not your water is free of sewage contamination.

As one health officer explains, "You can, by risking simple diarrhea, vomiting, or gastroenteritis, keep on drinking this contaminated water . . . but you would gamble with every fresh glass, because, if sewage is present, there may enter with it at any moment the germs of typhoid, cholera, or other deadly diseases."

Authorities agree that boiling water for five minutes will make it safe. Or, your health officer will tell you how to medicate it until you can find the cause of your well's contamination. Of course, if periodic tests show your water to be pure, you can "take it straight" . . . . . and enjoy every mouthful. Your well, you can be sure, is one of the lucky 25%.

(To Be Concluded)

New Range For The Bee

Persecuted by pesticides and clean farming, the bee now looks to man for help

By FRANK C. PELLETT

WITH the passing of the pioneer period of our American Agriculture, we have skimmed the cream of the virgin fertility from our soils. We are now finding it necessary to change our method from one of soil mining to that of careful conservation. Not only have we recklessly wasted the soil on which our very life depends, but, at the same time, we have dissipated so many of our natural resources that we are compelled to plan carefully to insure prosperity in future years.

Intensive cultivation of large areas, use of poison in the control of insect pests, and the clearing of fencerows and waste places has destroyed multitudes of wild insects on which we have depended to distribute the pollen to bring about fertilization of the blossoms of important crops. Yields of clover seed of from six to ten bushels per acre in pioneer times have dropped to an average of less than one bushel per acre in Mid-Western states.

These changes came so gradually that the public was not conscious of them until the situation reached a critical stage. Wild bees are mostly solitary in their habits and increase very slowly. There are hundreds of species ranging in size from half that of a housefly to the big bumblebee, and formerly there were always plenty to serve the needs of pollination. Since the honeybee is the only insect which can be controlled and can be moved to locations where such service is necessary, we have become largely dependent upon her for this help.

In order to meet the urgent need for bees when clover or fruit trees bloom it is necessary to provide pasture to support them throughout the year. In an effort to find plants which are more permanent and thus reduce soil erosion, and, at the same time provide good bee pasture, a test garden has been established on the writer's farm by the *American Bee Journal*. Hundreds of plants from many countries have been brought together. Among them are a few which are promising, although further test will be necessary before they can be extensively planted with confidence. Such crops should be profitable for other uses as well.

The introduction of new plants comes slowly. Special equipment for harvesting must be developed; their peculiar requirements for cultivation and handling must be learned, and markets must be provided. It required a century of time and two world wars to establish soybeans as a farm crop in America although they had been cultivated for centuries in Asia. The following plants are new to agriculture and would require time for acceptance even though their value was fully demonstrated.

Mountain Mint

There are said to be about sixty industries in this country, ranging from toilet soap to chewing gum, which make extensive use of essential oils as raw materials. The best estimate that I can get is that a million acres of land would be required to grow the plants to yield the essential oils that we now import from abroad. There is a small industry in this country, mostly in Northern Indiana and Michigan and along the North Pacific Coast, engaged in the cultivation of such crops as mints to supply this trade, but it is relatively unimportant to the agriculture of those areas.

Ten years ago the writer brought a clump of mountain mint (*Pycnanthemum pilosum*) to the test garden. Apparently the plant had previously been overlooked as a possible source of essential oil. Prof. Arthur Schwarting of the College of Pharmacy of Nebraska at once became interested when his attention was called to it and harvested our plot for distillation in the university laboratory.

The yield of oil was much larger than that secured from the mints already under cultivation, so similar distillations were made for each of the two following years with similar results. The Sioux Honey Association, a co-operative group of extensive beekeepers, then provided funds for a careful study of the oil and its possible uses. From this investigation it has been determined that the oil contains the following:—

Pulegone 80%
Menthone 10
Limonene 3 to 5
Menthol 2

Pulegone and menthone can be

Left: The new Asiatic clover 14 months after planting. Right: The root system of the clover two years after being started from root cuttings.

New Range for the Bee

Continued

converted to Menthol which is in good demand at attractive prices. They were able to take 100 cubic centimeters of the oil and by two steps produce 57 cubic centimeters of a mixture of the menthols. This indicates the possible value of the oil.

Distillations of plants from measured areas indicated a yield of about 200 pounds of oil per acre which should be sufficient to cover a relatively high cost of growing, harvesting and distillation and still return a profit to the grower. The first field crop was grown by Norman Pellett, a 14 year-old 4-H member, for purposes of demonstration of culture and handling as well as yield.

Further investigation will be necessary to determine just what purposes this new oil can be made to serve and whether a market can be developed, before there is time to encourage its planting for other than experimental purposes.

Wagner Pea

It has been many years since a German professor, William Wagner, was attracted to a wild pea which he found in the Carpathian mountains of Austria. He spent much of his life in selection and breeding this pea in an effort to provide a good forage crop which was also a good bee plant. When he finally offered it to the public there was much comment in the farm publications of the time, but apparently little interest in its cultivation. When we sought to find it for the test garden, many months passed before we were able to get a small amount of seed from Germany. After ten years of experience with this Wagner pea (*Lathyrus silvestris wagneri*) we are convinced that it will serve much the same purpose in the north that kudzu does in the south. It starts too slowly to be included in any ordinary system of rotation.

It requires three years to get it fully established but, once well rooted, it should last a lifetime. For steep hillsides, gullies and washes as well as lands that can be left for long periods of time, it serves a very good purpose. It outyields any other forage crop that we have tried. A light seeding is sufficient and we have had best success by planting about a foot apart in the rows spaced three feet or more apart. When planted too thick it blooms but lightly and yields less seed. By starting the seed in flats and transplanting to the open ground when seedlings are about four inches high, it is possible to get a good stand with very little seed.

The Wagner pea has been given extensive trial in Washington and is favorably reported by Maynard S. Grunder and Newell D. Dickson of the Western Washington Experiment Station. They report it as the only plant sufficiently aggressive to compete with the ferns on logged-off lands. In our plots the growth is so dense that a large dog is completely lost to sight when passing through it and there is a solid mat of green forage about four feet in depth.

A New Clover

Nothing in our test garden has aroused so much interest and enthusiasm as a new clover, *Trifolium*

ambiguum. It is a wild plant which grows in the Caucasus on the steppe lowlands, on the meadows, on the outskirts of the forests and in the mountain meadows even to the alpine zone. A few seeds came to us in a letter ten years ago and four or five plants were started from the few seeds. Since that time these have increased to hundreds of thousands and been distributed to experiment stations throughout the temperate world. Lacking a common name it has often been called "Pellett Clover" because of the fact that it was called to public attention in our garden.

Prior to coming into bloom, the clover looks much like red clover and reaches about the same height. The flowers are about the same color and somewhat larger than alsike blossoms. The root habits are peculiar since it spreads rapidly by rhizomes and a single plant will increase to several dozen within a few months of time. Since no seed was available, we have made increase by digging the plants and making root cuttings. These have been planted about 18 inches apart in the rows which are spaced three to four feet apart. When first planted these small plants coming through the ground look rather lonesome but in little more than a year have grown together to make a solid mass of clover with no indication where the original rows were placed.

There is one serious drawback to this clover thus far, and that is the fact that we have failed to secure the proper strain of bacteria to establish the development of nodules on the roots. Lacking this bacteria, the plants do poorly on most soils and, of course, fail to serve the normal purpose of adding nitrogen to the soil. We are told that in its native home the plant develops nodules heavily, so we assume that eventually this problem will be solved by securing bacteria from the original source.

The plant flowers profusely and when the bees visit the flowers freely it sets seed in abundance. Apparently it is entirely dependent upon insects for pollination, since little seed has been set when no bees visited the flowers.

For waterways and for erosion control generally, this clover is unequalled by anything we have tried, where it will do well. With the addition of the nitrogen gathering bacteria we anticipate much wider adaptation. The enormous increase of underground roots makes it difficult to turn under with a plow even though it is pulled by a heavy tractor.

Relatively few new plants have been brought into cultivation for a long period of time. There must be hundreds thus far overlooked which will serve a useful purpose. While there are hundreds of men engaged in research with our staple crops which have been grown for a thousand years, there are very few investigating the wild plants. Our ancestors brought with them the plants with which they were familiar and paid little attention to the great variety of native plants already acclimated here. There is great need of plants which are more permanent and do not require the constant stirring of the soil that results in so much erosion. Perhaps those above described may help to meet this need even though their value remains to be demonstrated.

This new clover from Asia, trifolium ambiguum, makes prime bee pasture.

Solving "The Size Problem"

Dr. Koentopp finds bigger oranges in bags of fertilizer

By JACK LEWIS

SINCE 1944, California citrus growers have been plagued by an annual headache known as the "small size problem." Where the fruit formerly was large in size and of good quality, it has become smaller each year until the point has been reached where some of the small sized oranges are virtually unmarketable on the fresh fruit market.

As a result of this, many growers have suffered financially, and this has been quoted as one of the several reasons why the California citrus industry has found its acreage of valencia and navel oranges steadily shrinking. The growers, apparently realizing that they can no longer exist on a marginal profit crop, are either subdividing their groves and allowing the West Coast migrators to build on them, or are replanting the land to avocados or even field crops such as lima beans and sugar beets.

There are a number of growers in the vicinity of Santa Ana, seat of the valencia producing area, who have been watching the work of Dr. A. P. Koentopp, one of the leading advocates of organic citriculture in the area. They are beginning to feel that he may have the answer to the size problem.

After more than a decade of experimenting in the field of organic fertilizers, Dr. Koentopp's groves this year yielded oranges averaging above the average sizes computed by West Coast packing houses.

This fact is particularly interesting when it is pointed out that many of the trees which are now heavy producers were poor trees only a few years ago. A number of them were even branded as being "worthless" by an agricultural official in the county, who told Koentopp that he would save money by pulling the trees and replanting.

Packout figures compiled by the Orange county house which handles Koentopp's fruit show that of the 1949 crop, 60 per cent was above what was considered the average size for the year.

In addition to this, oranges selected from this grove took every prize in the producer division at the Orange County Fair in August. His valencias took first, second and third prizes over hand-picked products presented by dozens of other growers and at least one marketing organization which had selected fruit from that offered by its marketing cooperators. In addition, he was awarded the Citrus Sweepstakes prize, a special award for having won the most points for showing top fruit at the exhibit. Other prizes which he captured at the fair included a first for Eureka lemons, first for Bearss limes and a second place award for navel oranges which had been on the tree since the preceding December.

With a showing such as that, it's little wonder that Dr. Koentopp is a firm believer in the organic way of agricultural production, and that his "followers" are multiplying.

Incidentally, a recent survey conducted within Orange county, California, the area in which Koentopp's citrus operations are taking place, shows that growers affected by the small size plague are in the habit of using excessive amounts of commercial fertilizers in an effort to regain the size and quality which has been lost. The survey conducted by the Agricultural Extension service of the University of California concludes that the excessive use of the chemical fertilizing mixtures does nothing to increase orange sizes, but costs the grower money which he often cannot afford to spend.

In Koentopp's operation, not only has the size of his fruit proved to be superior to that raised on neigh-

boring stretches of citrus land which is treated with chemical fertilizer mixtures, but consumers have expressed their delight with the increased quality and better flavor of the oranges.

Last year, he shipped several hundred bags of fruit to Eastern markets, and in each of the bags was a mimeographed sheet explaining in layman's language that the oranges had been raised under organic fertilization methods. Attached to each of the sheets was a postcard for consumer's comments.

Many of these cards were returned and some consumers even wrote letters asking how the fruit could be identified on the market as they wanted to purchase more of it.

A researcher in the citrus field who claimed that he did not like oranges and tasted them only when called upon to do so "in line of duty," said, "They are the best flavored, finest-textured and juiciest California oranges I have ever tasted."

According to the theory behind the Koentopp operation, if fruits, vegetables, *et al* are to contain the proper amounts of beneficial vitamins, minerals and other substances necessary for human growth and health, they should be fertilized organically. These fertilizers must consist of combinations that will increase the content of "good elements" and decrease the "bad."

A specific example of this is found in the fact that through his experiments and by fertilizing his groves with a carefully balanced organic mixture, Koentopp has succeeded in decreasing the amount of potassium found in the average orange. He has also managed to increase the percentage of calcium and other beneficial nutrients in the fruit, and as a result has increased the value of the fruit when used as food for the human body.

The potassium substance, which tends to neutralize calcium and retard its effect upon bodily growth, does not have nearly so strong an effect in Koentopp's fruit as in the average California orange. This fact has been proven by qualified chemists who have made a spectroanalysis of Koentopp's fruit and comparing it with similar analyses made from other fruit picked in the area. To accomplish this, as most of the readers probably know, it is necessary to burn the fruit reducing it to ashes and then scientifically analyze and classify the elements contained in the remaining ash.

DR. KOENTOPP SUPPLYING HIS FERTILIZER BY HAND TO A YOUNG TREE.

Solving "The Size Problem"

Continued

Dr. Koentopp first became interested in organic farming when a friend, a biochemist, showed him what could be done in gardening by combining organic matter with minerals to build strong and healthy plants. For the next few years his experiments in the field were largely of the backyard variety, and he tried numerous organic mixtures on his own vegetable rows with varied results.

He Began In 1940

It was in 1940 that he acquired a small orange grove on the outskirts of Santa Ana and began treating the soil organically. His first experiments in the citrus line involved the use of rabbit refuse which had been composted in a covered pit which prevented any of the vital elements and essences from leaching or draining away. This material was well broken down when applied to a section of his citrus orchard, but there was no immediate, marked result.

Koentopp later imported sheep manure from Idaho and spread it on his groves following the theory of some organic farmers that the low areas in the Idaho sheep country are most fertile, because the manure (and its elements) leaches and is washed down upon their land from the higher pastures.

As late as 1942, Koentopp's fruit was in the lowest size grade in the packing house through which he markets his fruit. The house, which handled the fruit of 89 different growers, has records showing that his fruit was listed as 69th for size and quality.

Through a careful program of organic fertilizing, the use of composted materials and later the addition of vital minerals and beneficial bacteria, Koentopp's fruit has risen in quality until in 1946 it was listed as fifth best being handled by the packing house. In the four year period that had ensued since his orchard products had been classified in the lower grade, the house had acquired many new customers so that the ratio had increased from the list of the original 89 growers.

Bacteria Hold the Secret

It was in 1945 that the doctor attempted his initial experiment in adding beneficial bacteria to the soil to help in increasing the quality and yield of his fruit. This consisted of planting special strains of bacteria near the feeder roots of the trees.

It has been reasonably well proven through experiments conducted by the University of California's college of agriculture and similar institutions that strains of destructive bacteria develop in the soils and about the roots of citrus groves which are 25 years old or more. If the trees are pulled for some reason and new trees planted in their places, the non-beneficial bacteria tends to retard growth and the tree, dragged down by this, seldom if ever equals the production record of the original tree in its best days.

Remembering this, Dr. Koentopp imported some 2500 pounds of what he terms "beneficial" bacteria which had been cultured and delivered to him from the East. He planted the ton and a quarter of bacterial culture around some of the trees in one of his groves. Using a mechanical posthole digger to auger into the ground near the outside drip line of the trees, thus getting the culture as close to the feeder roots as possible.

In explaining the role of the bacteria as he sees it, Koentopp compares the tree to the human body.

"Food is of no value to the body until it has been prepared in a form the body can digest and assimilate," he explains. "A potato, when consumed, must first be chewed, swallowed and processed by the stomach and its chemicals. Then the energy elements in the potato can be absorbed into the body and distributed to the various organs and tissues."

Comparing the tiny bacterial organisms to the teeth, tongue and stomach of the tree, Koentopp claims that they "prepare the plant food so the tree can absorb it and process it."

The bacteria is not a fertilizer and does not add food to the soil. It just makes available to the tree plant foods that are already in the soil. Koentopp feels that many of the commercial chemically-treated fertilizers actually defeat their purpose by destroying the bacteria.

In planting the soil bacteria, Koentopp claims to have improved the health of his trees, increased the quality and quantity of fruit, hastened maturity and added to the food value of the fruit, since the trees are able to assimilate more of the minerals and beneficial nutrients offered by the soil.

Dr. Koentopp's Fertilizer Is Balanced Plant Food

In recent years, Koentopp has gone a few steps farther and has compounded an organically-based fertilizer which contains not only the beneficial bacteria, but ground phosphates, several types of dextrose, vitamins and hormones. All of these purportedly help to improve not only the size, but the flavor of the fruit as well.

Soil analyses made by the Orchard Service Laboratories of Tustin, California show that the nitrogen content of the soil in Koentopp's grove has increased year after year although no commercial nitrogen products have been used as supplements nor is such material used in the mixtures which he uses.

"Though chemically-treated fertilizers may at times produce large crops, this does not necessarily mean it will supply good food with top nutritional content," says Koentopp. The reason for this, he feels, is a lack of proper mineral and biological activity in the soil. The theory which he has been pursuing during his nearly 15 years of research holds that with favorable humus, minerals and bacteria, soils can be rebuilt—or even new soils developed.

Books

Bromfield's Latest Tells More About Malabar Farm.

***Out of the Earth*, Louis Bromfield, Harper's, $4.00.**

MR. BROMFIELD has again undertaken to put on paper his philosophy of agriculture. Actually, it is a fairly sound philosophy, and he has expressed it eloquently. He has praised organic matter and the living and breathing elements in the soil. He has called our attention to the importance of healthy crops to the prevention of disease and the reduction of insect infestation. He has said insistently that we must stop farming as if we had unlimited land resources available and adopt the New Agriculture. But, adhering to the line of least resistance, he has emphasized that artificial chemical fertilizers are necessary.

On Malabar Farm, it seems, chemical fertilizers are used in conjunction with a heavy livestock and green manure program. Mr. Bromfield is careful to state that he is not a worshiper of artificial fertilizer. He realizes that it has limitations and emphasizes that it is folly to rely *only* on chemical fertilizers to supply nourishment to plants.

However, in my opinion, Mr. Bromfield is inconsistent in his reasoning. In one breath he speaks lovingly of the microorganisms in the soil—especially the antibiotic substances. In another, he says that chemical fertilizers and all their toxic residues are necessary, even on such a highly organic farm as Malabar. Mr. Bromfield must realize that he is disturbing the delicate balance of his soil by introducing into it the soluble salts of chemical fertilizers.

This dependence on chemicals by a man so in love with the soil might be overlooked if the world of agriculture had not yet realized the effectiveness of native rock fertilizers. Mr. Bromfield completely neglects these long lasting, economical and trouble free nutriment suppliers, described in detail on page 10 of this issue by Dr. Keller of the University of Missouri. Certainly he could substitute the commonly used rock phosphate for the artificial phosphate suppliers. At present, Mr. Bromfield uses chemical fertilizers to "start" fields of low productivity. By using rock fertilizers he would get almost as fast results plus a long range, adaptable program of mineral replacement that would have infinitely more bearing on the agricultural situation of the country as a whole.

Our problem today is one of maintaining and gradually replacing the minerals and organic matter that our negligent forefathers squandered. Chemical fertilizers, with their short period of availability, toxic qualities and expense, are not the answer. Ground rock fertilizers may be what the farmers of this country are looking for.

Bromfield stumbles over the potentialities of these natural fertilizers when he talks of the vast mineral treasures that lie in the subsoil under Malabar Farm. By inaugurating a program of subsoil mining—using deep rooted legumes as his miners—he is, in a way, using ground rock fertilizers. However, the Achilles heel of Bromfield's subsoiling program, and he realizes it, is that he is extremely fortunate in having a subsoil made up not of clay or inert rock like most farms, but of rich gravel pulverized and homogenized by the Ice Age glaciers.

On the whole, however, *Out of the Earth* is a worth-while book and contains not a few admirable statements. I particularly like Mr. Bromfield's attack on the curative concept of medicine which is so popular today and his conviction that disease should be prevented through nutrition and the soil. He states that his policy of drawing to the surface the subsoil minerals at Malabar has resulted in the improved nutritional quality of crops and the disappearance of disease.

* * *

There is one "error" in this book which I feel should be pointed out. I quote from page 73: "One of the cases cited frequently in refutation of the strictly organic, compost school of farming is the test plot at Roehampton in England, where good crops of wheat have been grown every year for three generations by the use of chemical fertilizers alone." I take it Mr. Bromfield is referring to the *Rothampstead* experiments, but the error I wish to point out is that these experiments have shown the superiority of organic fertilizer, not chemical fertilizer.

To back up this statement I quote from page 811 of the 1938 Yearbook of the Department of Agriculture: "In long continued experiments at Woburn and Rothampstead in England it has been found that stable manure has maintained the fertility of the soil over much longer periods than have the chemical fertilizers containing nitrogen, potash, phosphorus and sulphur."

—R. R.

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—*Anonymous*

Memos To Farmers

The Fertilizer Industry's Influence Is Becoming a Menace

The Congressional Record of March 8 carried an enlightening report on the fertilizer industry by Representative Usher L. Burdick of North Dakota. Portions of it are reprinted here:

"Mr. Speaker, in my remarks on October 10, 1949, I drew the attention of the Congress to the fact that eight Members of the United States Senate had protested against the monopolistic practices of the fertilizer industry, and had asked for an investigation; and that the distinguished Representative from Wisconsin, the Honorable FRANK B. KEEFE, and the distinguished Representative from Illinois, the Honorable ADOLPH J. SABATH, had each offered resolutions requesting the appointment of a special committee to make a full and complete investigation of the fertilizer industry, and to find the facts in connection with the statements recently made by competent judges that present methods of fertilizer manufacture are not only responsible for unnecessarily increasing the amount of the farmer's national fertilizer bill $250,000,000, but are also the cause of the extensive spread of destructive plant diseases, and of the increased incidence of vascular diseases and degenerative diseases.

There are serious matters, Mr. Speaker, but the most serious phase of this matter is the fact that Federal court records show that a large number of fertilizer companies were indicted and fined for having exerted an illegal influence on State lawmakers, and that while this influence was being exerted, the State laws were so amended as to allow the manufacturers to lower the quality of fertilizer by using excessive proportions of the cheap, soluble sources of nitrogen without letting the farmers know that this was being done.

A letter dated February 25, 1950, written by Mr. William G. Holman, a well-known citizen of Virginia, to Mr. Osborne B. Bond, publisher of *Liberty* magazine, Chicago, Ill., contains some statements far more shocking and serious in their implications than any that have heretofore been brought to the attention of the Congress in connection with

this matter. I ask that Mr. Holman's letter be inserted in the RECORD as part of my remarks.

The time has come, Mr. Speaker, for the Congress to inquire into the charges of collusion, and to take such steps as are necessary to free the fertilizer industry from monopolistic control which is proving to be a detriment to the health and welfare of the people, and obviously a detriment to the morals of public officials. To do otherwise would sound the death knell to popular government in this country, and all of us know that popular government throughout the world was never in greater peril than it is today.

The letter referred to follows:

WASHINGTON, D. C.,
February 25, 1950.

MR. OSBORNE B. BOND,
Publisher, Liberty Magazine,
Chicago, Ill.

DEAR MR. BOND: If we really had free enterprise, would it be possible for "one-eighth of 1 percent of all the corporations in America to acquire 51 percent of the Nation's assets," and would it have been possible for 3 percent of the farmers in America to own 41 percent of the farm land?

If we really believed in free enterprise would we shrug away and do nothing about the criminal exploitation of the farmers by the Fertilizer Trust, and fertilizer practices that endanger the health of the people?

Would we condone the leasing of public lands to a few corporations on which are found the principal potash deposits in this country which enabled these corporations to obtain a monopolistic control of such an essential fertilizer ingredient as potash and to use this control to the harm and injury of the farmers?

Would we meekly submit to the encouragement given to a few fertilizer manufacturers though an Act of Congress (Webb-Pomerene Act) to acquire a monopolistic control of such essential fertilizer ingredients as phosphate rock and acid phosphate, and to the use of this control to force the smaller manufacturers to lower the quality of fertilizers, and thus impose upon the farmers and endanger the health of the people?

Sincerely yours,
William G. Holman.

An English Farmer's Yearbook

A copy of *The Farmer Yearbook and Diary for* 1950 was recently sent to us from England. It is an interesting and helpful little book, full of short articles on farming plus space to keep a daily record of farm activities. Delightfully English in content and format, it can be purchased for the equivalent of seven shillings from *The Farmer* magazine, Goosegreen Farm, Bridgwater, Somerset, England. The same firm has also published *The Cure of Canine Distemper and Hard Pad* by Juliette De Bairacli-Levy which can be purchased for ten shillings.

—R. R.

You still have time to enter our "Organic Methods" contest.

Write 500 words or so about your farm, your yields, your fertilization program and about any other phase of your operations that you think would be interesting to other farmers. Title it "How I Use the Organic Method" and send it to us. Prizes total $105. The best entries will be printed in the Organic Farmer.

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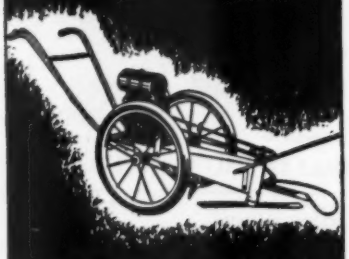

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Poultry

Disposal of Dead Birds Need Not Be a Problem

Dead chickens are the mark of either a poor or an unfortunate poultryman. To be sure, they crop up in the best of poultry establishments (even on our experimental farm a chicken has been known to die of old age occasionally). However, a dead chicken need not be a complete loss. As fertilizer—feathers, bones and flesh can not be beat.

John Moyer, our friend from Bally, Pa., has a unique disposal method. He merely lifts one corner of the mulch over his vegetable garden and tucks in the dead bird. Within a few months, all that remains is a brittle skeleton. All the animal matter in the chicken's body has been transformed into plant food.

Of course, this simple method can lead to extreme difficulty if there is any disease present in the flock. The disease organisms in a dead chicken are prone to multiply and spread unless precautions are taken to set up a barrier between your flock and dead birds.

If they occur in any quantity, dead chickens should be placed in a special compost heap or pit located out of reach of your flock. The resultant compost, if it has heated properly, will be relatively free of disease organisms. Hatcheries often have large quantities of dead chicks and egg shells that are extremely well suited to composting.

Of course, if you are confronted with a knotty disease problem, it would be best to completely isolate dead birds by burning or burying them.

Livestock

Beet Tops Are Good Feed

Thousands of tons of valuable, nutritious sugar beet tops are wasted every year. It is satisfactory livestock feed which could be utilized in a number of ways.

This feed is a by-product of the sugar beet industry. A large proportion of the beet tops are plowed under and only a very limited number used as livestock feed.

It is true that the tops have fertility value, but a lot more value could be realized by feeding them to livestock and then putting the manure produced back on the land. The volume of feed that is wasted is demonstrated by the fact that the tops from an acre of beets will weigh about one-half as much as the marketed beets.

Beet tops can be utilized as feed for cattle and sheep in a number of ways. They may be pastured, made into silage or dried. Probably the most practical way to utilize them is by making them into silage. Beet top silage can be made in upright or trench silos or by merely making a large pile of the green tops.

If the silage is made in a pile on the top of the ground, the pile should have smooth sides and the larger the pile the better. There will be some spoilage around the edges by this method but it has the advantage that no building is required.

Reports from foreign countries have shown that dehydrated beet tops are about equal in feeding value to oat grain. If a high quality feed is to be obtained, some means of removing the soil from the tops must be used. In Germany this is done by either washing them before they are dried or by shaking the dirt out of the dried product. —R. R.

Native Rocks as Fertilizers *Continued*

tions, bacteria, and soil from all sides. Moreover, many tiny particles of decomposing rock will provide many foci of liberated nutrients for the plant rootlets on the lookout for them.

Silicate rocks should be pulverized finer than the carbonates, namely limestone and dolomite, because silicates are notably less reactive to soil acids.

Heretofore we have concerned ourselves only with artificially pulverized rock (volcanic ash excepted). It will be interesting, and certainly reassuring, to digress and recall that natural geological agencies pulverize and also spread rock dust over soils, thereby adding to their fertility. Finely powdered rock silt may be washed over river bottoms at time of flood and settle out to add to nutrient reserves. Wind-blown dust, the loess deposits, have added uncounted tons for fertility to lands upon which it has fallen. Rock flow and pulverized fragments produced by the grinding action of glacial ice have enriched millions of acres of land in the northern half of our United States. Hence the principle of adding pulverized rock is fundamentally sound and long proved to be naturally successful.

Occasionally the river silts, or the glacial sand and silt have been composed almost entirely of quartz which is barren of nutrient elements, and is most resistant to weathering. Under that condition the added material has been detrimental. For the same reasons the quartz of granite (usually 10 to 30% of the rock) does not contribute to soil fertility.

Agricultural Stone is a Native Fertilizer

From the preceding discussion it should be evident that agricultural stone can vary widely in character, composition, and source. Whereas "agstone" was once viewed as an accessory, or as a "poor relative" of the fertilizers, truly it ranks with any of them. Agricultural stone is simply a native fertilizer, period!

Already agricultural limestone producers are preparing to blend with their quarry products certain other native rocks and minerals or slags to furnish "tailor-made", or "fortified" agstones. One supplier has mixed a silicate and a phosphate rock. The possibilities of agstone blends to meet particular soil needs are almost unlimited.

The economics of quarrying, crushing and particularly of transporting heavy and bulky agstone will play an important role in determining what rocks can be blended with others, or how wide-spread is the service area of each.

The organic farmer has unexcelled opportunities to restore the fertility of his soil by adding pulverized rock of appropriate composition and abundant organic matter.

If the farmer needs assistance in locating rock of a desired composition, he is advised to inquire about it from his state geologist. He should be prepared to use alternate blends or sources because no geologist can create rock deposits, he can only direct a consumer to what has already been found. Moreover, be patient for not all deposits of agricultural rock fertilizer have been recognized because the industry is only in its infancy; past users of rock fertilizers have been pioneers.

In retrospect, when early settlers depleted the fertility of their soils, many of them moved on to unworked lands. Now that there is no "new" land to take over, we are confronted with the problem of restoring, replenishing, and improving with that at hand. The preferred method to do so is to follow the pattern established for ages by Mother Nature—to use for fertilizer organic matter and the native rocks, the sources from which our enviably rich, virgin soils derived their high level of fertility. By that method we can not go wrong.

Glossary of Geologic Terms Used in Dr. Keller's Article

Alunite—A white mineral, a sulfate of potassium and aluminum with six-sided crystals.
Anorthosite—A granular igneous rock made up of plagioclase. (see plagioclase)
Basalt—A basic rock of plagioclase with olivine augite, commonly dark colored.
Dunite—An ultra-basic igneous rock.
Feldspars—A closely related group of minerals, all silicates of aluminum, with either potassium, sodium or calcium.
Gabbro—An igneous rock made up of dark minerals and some feldspar.
Glass—In nature, it is a transparent and brittle compound of silica.
Glauconite—A loosely granular olive-green mineral often rich in potassium and iron.
Gneiss—A "squeezed" rock made up of broken up sheets of other rock.
Granite—The most common "foundation-stone" of continents, it was formed by the slow cooling of molten rock below the Earth's surface.
Igneous rock—"Fire-formed" rock, the result of the cooling of molten rock called magma beneath the Earth's crust.
Lava—Molten rock poured into the atmosphere.
Leucite—A white, potassium-rich mineral.
Loess—A fine grained, erosional sediment, deposited by wind, covering vast areas in Asia, Europe and North and South America.
Magma—Molten rock at depth.
Metamorphic rock—"Squeezed rocks," their character changed by temperature, pressure and other factors acting beneath the Earth's surface.
Olivine—A common greenish mineral occurring in dark "fire-formed" rocks.
Plagioclase—A type of feldspar made up of sodium, calcium and aluminum silicates.
Peridotite—A basic igneous rock, without feldspars.
Schist—A metamorphic rock made up of even, crystaline layers containing large amounts of mica.
Silica—The principle constituent of quartz and sand.
Slate—A minutely grained metamorphic rock which can be split in thin, parallel sheets.

PREVENTION

A NEW MONTHLY MAGAZINE will be published under the editorship of J. I. Rodale of THE ORGANIC FARMER, to be devoted solely to the conservation of human health, stressing exclusively the prevention of disease; not the cure for it. The name of the magazine will be PREVENTION. The only magazine of its kind ever published, it will be conducted on an extremely high plane. No advertising of medical or health products will be accepted, but PREVENTION will make editorial comment on products which it feels worthy of mention.

Mr. Rodale's first interest was in the field of general health, and about eight years ago he was the publisher of "Health Guide". This magazine was discontinued so that he could concentrate on his new publication, Organic Gardening. But now, thousands of his readers have shown such an interest in health matters (and are continually writing to us for health information which we do not believe to be within the province of a gardening publication), that we feel it necessary to start this new publication, the material for which will be written by experts.

Organic Education in the Cities

We are starting PREVENTION for another reason. Through Organic Gardening and The Organic Farmer we are reaching farmers and gardeners, but we have no way of reaching the general public that neither farms nor gardens. In seeking circulation for PREVENTION Magazine, we will go into the cities. Thus we will have a means of describing the evils of chemical fertilization to an important new segment of the population, so that they can raise their voices in the strongly-growing movement against chemical fertilizers, poison sprays, and preservative poisons in foods.

We want to build the organic movement stronger and stronger.

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The first issue will be out about May 15th. Consider the cost not as a subscription to a magazine, but as a medical fee to enable you to keep posted on the latest discoveries in the prevention of disease, and to stay healthy. Better to pay this small fee than to pay the doctor!

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The Farmer Composters require thirty days to process waste organic matter into humus fertilizer. Scientifically built and of all steel construction, they are available in the following sizes: 30 Ton capacity; 50 Ton capacity; 75 Ton capacity; and 100 Ton capacity.

Well Driller
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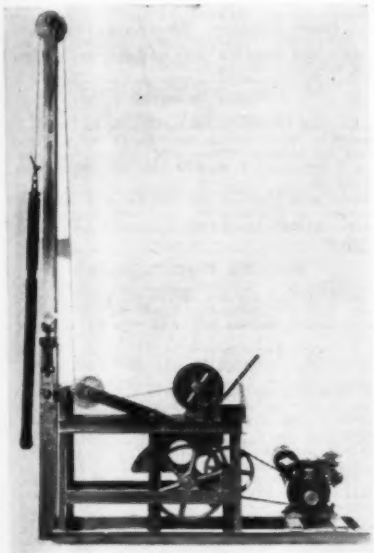

home owners to drill their own wells with ease and at low cost. The Junior model, pictured above, will drill through any kind of soil, hardpan or rock. Drills are furnished.

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This ladder is mounted on a special wheel carrier which makes it self-supporting. A light weight implement, it makes quick and easy movement around and between trees possible. The Wheel Ladder also reduces the number of ladders needed to harvest a crop, since the tree may be picked from top to bottom with this implement alone.

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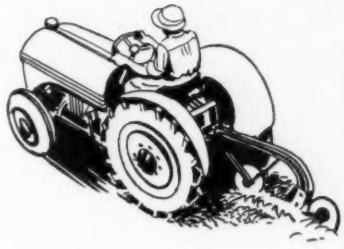

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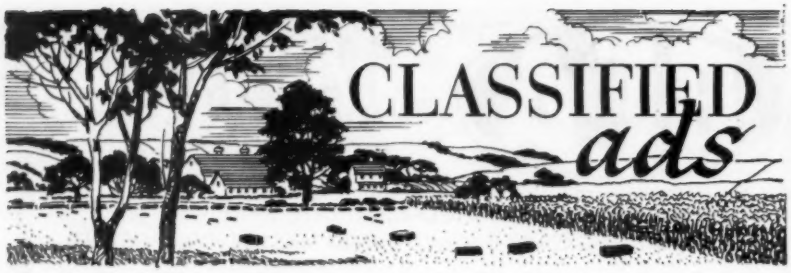

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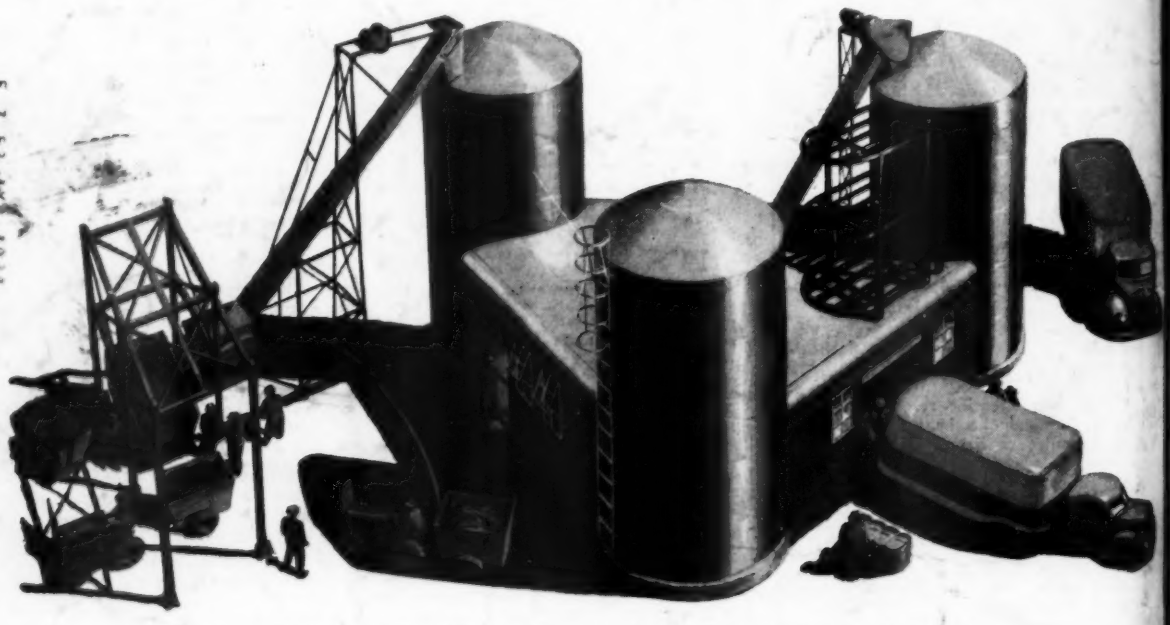

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